VOLVME VI APRIL 1897 No. 4

THE BRICKBVILDER

OFFICE 85 WATER STREET BOSTON

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

ROGERS & MANSON,

CUSHING BUILDING, 85 WATER STREET, BOSTON.

P. O. BOX 3282.

Subscription price, mailed flat to subscribers in the United States and Canada	$2.50 per year
Single numbers	25 cents
To countries in the Postal Union	$3.50 per year

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Entered at the Boston, Mass., Post Office as Second Class Mail Matter, March 12, 1892.

THE BRICKBUILDER is for sale by all Newsdealers in the United States and Canada. Trade Supplied by the American News Co. and its branches.

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THE BRICKBUILDER is published the 20th of each month.

BRICK BRACING.

THE constructive importance of brick masonry has during the past twenty years undergone several distinct modifications. Before 1880, the approximate date when skeleton construction first made its appearance, the masonry construction was depended upon to resist static loads as well as to afford rigidity to walls when subjected to lateral or angular strains. The principle was entirely one of inert resistance to thrusts, and the mass of masonry by its cohesion and dead weight afforded the required stability. The introduction of the steel frame brought about what at first seemed to be a radical change in the function of masonry, which from being a supporting member was considered simply as an envelope, a protection, or a mere external adornment to the hidden vital sinews of steel; and all of the calculations of recent years which have been made looking to a determination and resolution of wind strains have assumed that these are taken care of entirely by the bracing or the arrangement of the members of the steel work. There is, however, another function which brick masonry in these modern structures should possess, the necessity for the observance of which is being recognized by our constructors. In the newspapers, which often reflect only a suggestion rather than an exact statement of fact, we sometimes read that a certain building is constructed so strongly that if it were set up on edge it would not distort, and that to all intents and purposes the high building, if properly constructed, is practically a huge cantilever or beam, the lower end of which is thoroughly fixed in the ground. There is no scientific reason to believe that this is an exact statement of fact, and yet after the steel frame has been calculated to provide for every possible strain that would theoretically come upon it, the building receives an enormous addition of rigidity by reason of the brick filling which is added to it; and if, as is the practise in much of the work, the supporting and bracing members are reduced to a minimum expanse of cross section and thoroughly built around by the masonry so that the bricks can tie in through all the parts of the frame, the resulting rigidity is a very considerable element in the stability of the structure. Any one who has had occasion to investigate the stiffness of the steel skeleton before the terra-cotta floor arches and the brick envelope are in place must have noticed the extent to which the frame is affected even by the rumbling of passing teams in the street, and in a high wind the steel frame is jarred very perceptibly; whereas in the completed structure, when the steel frame is properly housed in the brickwork and the floor arches are thoroughly laid, even the tallest of the buildings which have been erected within recent years are not perceptibly affected by the most severe gales, while they seem to be absolutely unresponsive to any jarring or rumbling caused by teams on the surface of the ground. In other words, while the steel skeleton has in a sense replaced a very considerable portion of the constructive value of brickwork, by itself it is not sufficient to afford the necessary rigidity required in a modern structure, and the brickwork plays a very vital part in making the building habitable, and preserving it from the vibrations which in time would cause disintegration if not destruction. We have in mind at this moment a sixteen-story office building which was constructed by a firm of architects who are acknowledged masters of their profession, in which the system of cross bracing to provide for vibrations and wind strains was carried to the scientific limit, the brick walls being treated, however, merely as curtains, and reduced to the least possible areas of cross section, with the result that after an occupancy of a little over a year the vibrations in the building were found to be so great that it became necessary to build two heavy brick cross walls inside of the building from foundation to roof in order to acquire the needed stiffness. In another very prominent building, the movements of the steel frame before the brickwork was in place were such that it was not thought prudent to even build in the floor arches until after the external walls were carried to a considerable height, lest the action of the wind upon the floor surfaces should bring undue strain upon the steel work. These examples illustrate the necessity of care and good workmanship, and serve to emphasize the constructive functions of brick masonry, even when the envelope is carried independently by a scientifically designed steel skeleton.

THE QUESTION OF COLOR—A CONTRAST.

A POPULAR belief does not differ from a popular skepticism in point of endurance. When once fairly established, it becomes a cherished habit of thought, and whether right or wrong, is not easily effaced. It clings to the imagination and continues to influence our judgment in spite of overwhelming facts to the contrary. The evidence of our own eyes, though admittedly conclusive in ordinary affairs, is not always sufficient to eradicate a prejudice of long standing. "Give a lie twenty-four hours' start, and it will have accomplished its mission before the truth has overtaken it." This maxim, though formulated by an experienced politician, has a substrata of truth, and may be accepted—in this case *cum grana salis*. It

is notably the case in regard to the supposed want of uniformity in the color of terra-cotta, when compared with that which may be relied upon in stone taken from the same quarry. Yet the facts do not justify any such sweeping conclusion. We have seen terra-cotta rejected, or what is nearly as bad, belied, on these grounds, though it was not less uniform in color than stone which had been accepted and set in the same building without a murmur of complaint. In like manner we have seen stone accepted simply because it was stone, when the same variation in color would have been deemed sufficient cause for the rejection of terra-cotta. Or, if its use had been permitted at all, it would have been under protest, and after the whole vocabulary of opprobrium had been exhausted. Such is the force of unreasoning prejudice. In this respect, at least, the captain's "choleric word," coming from the mouth of a corporal, is still held to be "flat blasphemy."

Whatever may have been the relative condition of things, say ten, or even five years ago, they have undergone changes in the interval of which the general public — even the building public — are not fully cognizant. Not only have they changed, but there is good reason to believe that they have in many instances been reversed. Indeed, the signs pointing in the direction of this reversal are so general and emphatic that their existence cannot much longer remain a subject of debate. We will give a few of them for the benefit of any one who may doubt this proposition. We would invite him to take an impartial look at the Sixth Avenue entrance to the Siegel-Cooper Building. Plate glass and steel constitute most of the first story, but the elaborate entrances are limestone. All other parts of the immense building are cream-white terra-cotta and brick of remarkable uniformity. We need not rest our contention on any isolated example, for instances of this kind are becoming plentiful, and they are not confined to buildings of minor importance.

The new Astor Hotel, on Fifth Avenue and 34th Street, now approaching completion, is an operation of such magnitude and grandeur that the adjoining Waldorf appears little more than an annex. The prevailing color in this case is a glowing hospitable red. The predominating material is terra-cotta. Seventeen stories of Flemish Renaissance towering into space, and terminating in a highly picturesque sky-line. Fourteen of these stories are red terra-cotta and red brick, the three lower stories being stone of varying degrees of redness. The *absence* of uniformity in the color of the stone is sufficiently marked to attract the attention of a casual observer. It becomes more aggressive if he lingers long enough to inquire into the cause, or speculate upon its ultimate effect as an aptly instructive object lesson. Tenacious indeed must be the popular belief, or delusion, that survives the shock of this silent, unanswerable demonstration.

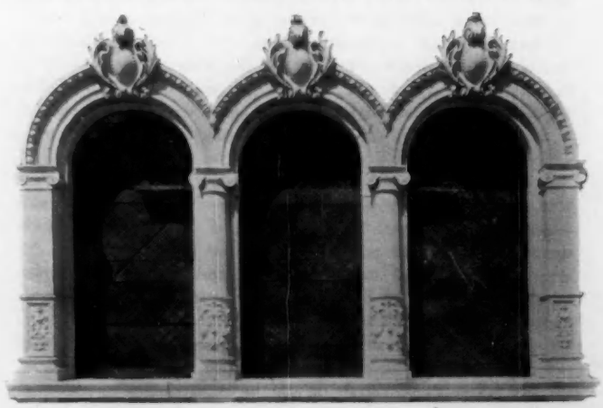
At first sight it might be surmised that the stone had been obtained from at least two quarries, but we have been assured that this is not so. It is of course supposed to be cut in a way that will permit it being set on its natural bed, but this good rule may not have been adhered to in all cases, and wherever departed from, in addition to being less durable, we get a different texture, which would to some extent account for the difference in shade. The method employed in working the stone is another element that has now to be reckoned with, viz., whether it has been tooled by hand or by machine labor. A conspicuous case of this kind may be seen in the cartouche window transoms on the westerly side of the 34th Street elevation, which, being richly carved, represent the color effect produced by hand labor. The contrast presented by the work on the intervening piers, which has evidently been tooled in a mill, is very decided. The more delicate touch of the carver has cut without abrading, leaving the grain of the stone favorable to the absorption of light. The automatic and less sympathetic action of the machine has stunned the surface of the stone, producing an entirely different effect, which, in turn, goes far to produce a difference in color, that otherwise would not have been so pronounced. But it must be remembered that this is in stone; and being so, we are expected to close our eyes to its defects and shortcomings, lest anybody should think us capable of flying in the face of nature.

We may not go so far as the satirical Mr. Whistler, who, when a patron remarked that a certain landscape called to mind one of his pictures, replied, "Ah! I'm glad to hear that nature is learning. But we will go far enough to assert that men are learning to assist nature by taking advantage of nature's laws and of nature's bountiful store of raw material in the production of building blocks more even in color, and altogether free from the laminations inherent in her own product.

THE removal of brick edifices which were erected in the early part of this century often causes comment upon the thorough manner in which many of them were constructed. While there are numerous exceptions to this rule, and it by no means follows that all of our old buildings were well built or substantial in character, it is true that the work of the early part of this century was in the main of a very high constructive value. This was due largely to care and intelligence in the use of material, but also quite largely to ignorance. With the idea of making things strong enough, a pier or wall would often be made widely in excess of the exact strength required. It is only within quite recent years that the extent to which first-class brickwork can be loaded has been fully appreciated. The practise twenty or twenty-five years ago was to allow a load of not more than 6 or 7 tons per square foot bearing upon thoroughly first-class brickwork, whereas now by law in Boston we are allowed to put as high as 15, and judging by experiments which have been made at Watertown and elsewhere, there would be a sufficient margin of safety in some cases if the bricks were loaded to 25 tons per foot. This, of course, implies the utmost care in construction, with the best of mortar and intelligent bonding of the bricks. While the statute limitations are advisable, the tendency of modern building methods has been to reduce the factor of safety in proportion as the extent of positive knowledge of resistance of materials has increased; and whereas in the days of our forefathers the intelligent engineer would use a factor of safety of 6 to 10, we are now perfectly content with one of from 3 to 4, and this with our best modern constructors is really a factor of safety, based upon actual knowledge, and not a factor of allowance for ignorance.

ILLUSTRATED ADVERTISEMENTS.

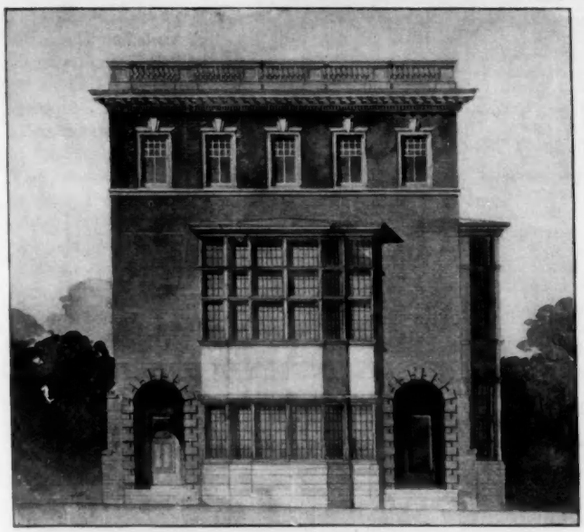
THE accompanying triple window is one of four used in a block of high-class residences in New York City, of which Messrs. Neville & Bagge are the architects. The illustration shows the work set up temporarily just as it came from the kiln, and previous to its being shipped along with other work of equally good design, from the works of The New York Architectural Terra-Cotta Company.



CHARLES T. HARRIS, LESSEE, takes a full page (xxvi) this month on which to give a partial list of buildings which have been roofed with the Celadon Terra-Cotta Company's tiles. This page will be found to be of especial value, as not only is the name of building given, but location, style of tile used, and architect, as well.

Brick and Terra-Cotta at the League Exhibition.

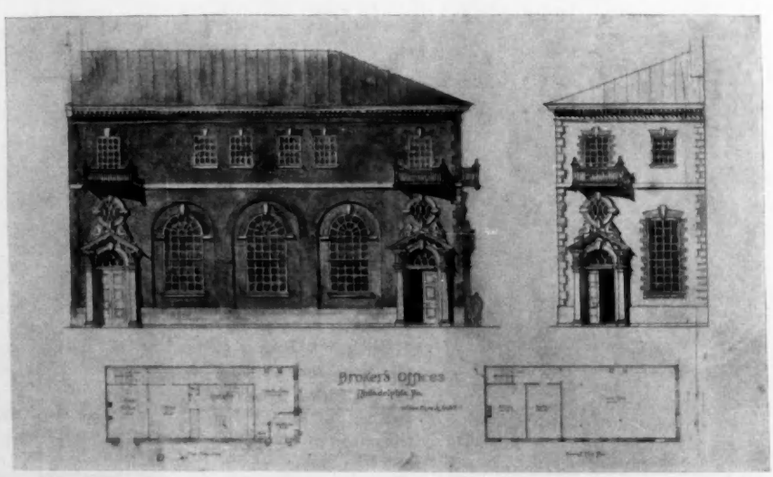
THE annual exhibition of the Architectural League of New York offers an excellent opportunity for studying the tendencies of current work and for observing the lines upon which study for future work is being conducted. The exhibitions held by the league have every year grown in interest and in scope, and the one which closed the fifteenth of last month is quite in the line of regular progression, including work from many parts of the country, and to a very considerable extent representing the best talent of the profession. As in previous years, a considerable space is devoted to the work of the so-called allied arts, a term which can be conveniently stretched or restricted to suit almost any desired classification. Had the exhibition been confined more closely to purely architectural effort, it would in some respects have been more interesting to the architect, though, judging by observation the day we were in the galleries, the arts and crafts attracted more visitors than the drawings, and the combination is always a good one even if it goes no further than to show how haltingly architecture has developed of late years by comparison with the sister arts.



HOUSE FOR DR. J. W. PUTNAM.
Green & Wicks, Architects.

The first impression given by the architectural portion of the exhibition is that an immense amount of work has been expended by exhibiting architects merely for the production of show drawings, which, as far as actual study or application to real architecture is concerned, have a relatively slight value. Many of the drawings are overdone, and not only is a great deal of detail work suggested, but a great deal is actually put on drawings which, if they were rendered more lightly, with less attempt to produce pictures, would in many cases gain directly in proportion to the simplicity of treatment. This is emphasized by the few, but very large French drawings which are exhibited together at one end of the hall, which, however one might criticize the design, are certainly rendered in a style which somehow or other seems to be acquired only in Paris, the least possible work being expended to secure the greatest effect. The over-working of the American drawings seems to be specially noticeable in connection with the buildings which are intended to illustrate brick or terra-cotta designs. Brick suggests color, and color evidently means paint, for the majority of the brick drawings shown are very strongly colored, and instead of being indicated, the tones are laid on with a heavy brush. Somehow, simplicity and terra-cotta are hard to combine on paper, at least, and though a quiet, dignified treatment is naturally associated with brick, when we begin on terra-cotta the details run riot; and the knowledge that ornament will repeat so easily in this plastic medium without arousing the bugbear of expense, that *bête noir* of true art, seems to limber one's fingers and stimulate one's inventive faculties until it requires firm repression and deliberate self-control to abstain from encoring one's designs.

Brick and terra-cotta alone, and in combination with other materials, were very much in evidence in the exhibition, — indeed, we cannot recall any collection of architectural designs in which so large a proportion were intended to suggest burnt clay. And this is speaking simply from the external evidences. Undoubtedly there were many drawings which were intended to represent brick or terra-cotta, but which for the purpose of the exhibition were not specific. The distinction in style between stone and terra-cotta is one that is seldom made in a perspective drawing, and consequently many designs which have the appearance of monumental stonework may be intended in the mind of the designer to be worked out in terra cotta; so that while terra-cotta work, as such, was not specially prominent, there were a quantity of designs which one would reasonably expect to be carried out in clay, though there was less special attention to giving it a terra-cotta character than we would like to see. But of brick there was a lot, and on the whole very satisfactory. One of the first designs near the entrance of the gallery was the government drawing of the proposed post-office at Pawtucket, a combination of brick and stone worked out in a quiet, dignified manner and forming a very pleasant composition. And, by the way, what a relief it is to feel that at last we have a government architect who is competent to design a creditable building! There were exhibited two other post-offices due to Mr. Aiken's taste, that at San Francisco and the one at Pueblo, Cal.,

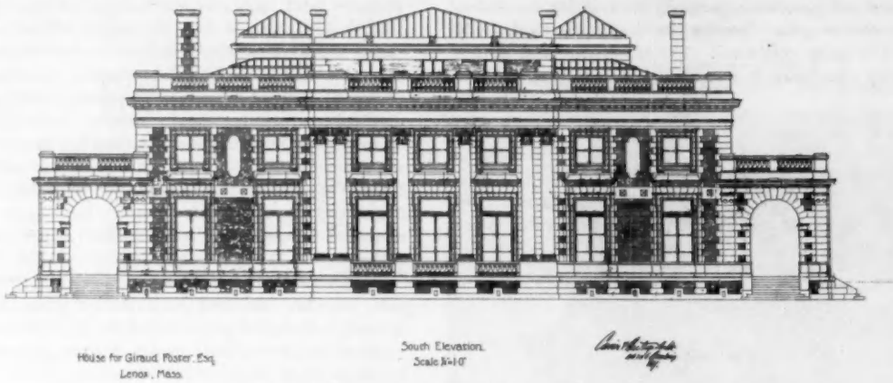


DESIGN FOR A BROKER'S OFFICE.
Wilson Eyre, Jr., Architect.

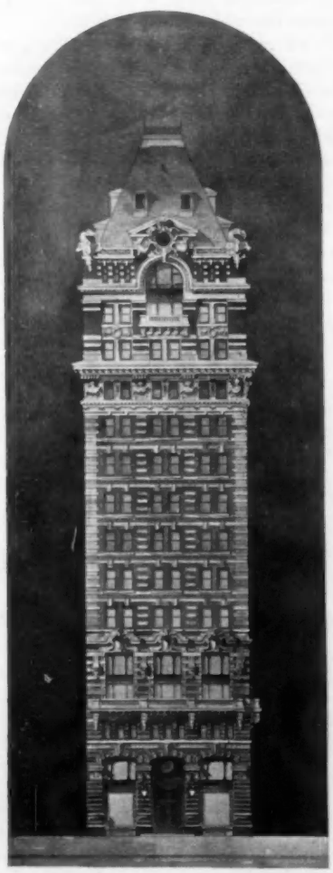
both of which are admirably designed, seem fitted for the location, and are in marked contrast to the stuff which the government architect's office has put out in the past. And to think that we, of Boston,

have that horrible, cold granite monstrosity for a post-office, which is too solid to wear out, is not built to burn, and we cannot hope that a providential cataclasm will ever remove it from our midst!

The drawings exhibited by E. Raymond Bossange, of the house at Scarborough-on-the-Hudson, presented a charming combination of brick and half-timbered work, rendered in the most delicate water-color, and affording, with its green roof and polygonal tower, a charming composition in color. The house is perched on a high knoll, with irregular plan, permitting of a large brick tower; the lower story is all of brick, the upper stories half timbered and plaster work. Close beside this was a design by Edward P. York and Philip Sawyer, for a recitation hall at Vassar, a straightforward, well-worked-out Elizabethan composition of red brick with stone trimmings. Longfellow, Alden & Harlow exhibited a drawing of a large house at Alleghany, also in red brick, with an added red tone in an intensely strong tile roof.



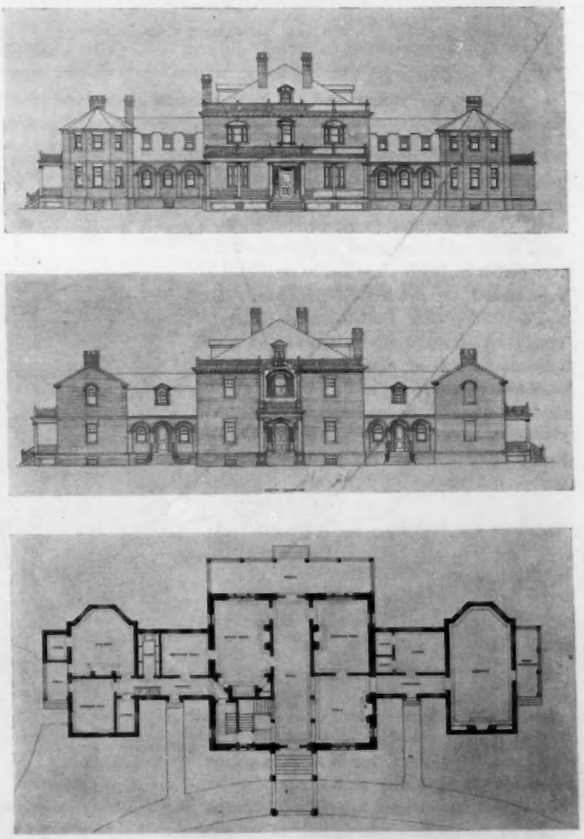
HOUSE FOR GIRAUD FOSTER, ESQ., LENOX, MASS.
Carrère & Hastings, Architects.



DESIGN SUBMITTED FOR WASHINGTON LIFE INSURANCE COMPANY BUILDING.
Walker & Morris, Architects.

One of the most charming studies in the exhibition was Carrère & Hastings' house for Giraud Foster, at Lenox. It is indicated to be constructed of brick, with trimmings of light stone or terra-cotta, and is thoroughly delightful in every respect, with a carefully studied academic setting, not shown in the cut which we publish herewith. The drawing exhibited was rendered in full color with all the accessories, and the accessories are so charming that one questions whether the trees and shrubbery which are shown to such an advantage were planted for the house, or whether the house was planned to come so nicely between such well-balanced, mighty oaks. As an example of the possibilities of an architectural treatment of masses of foliage, and of symmetrical gardening, it is eminently successful.

The design for York Hall, New Haven, by Grosvenor Atter-



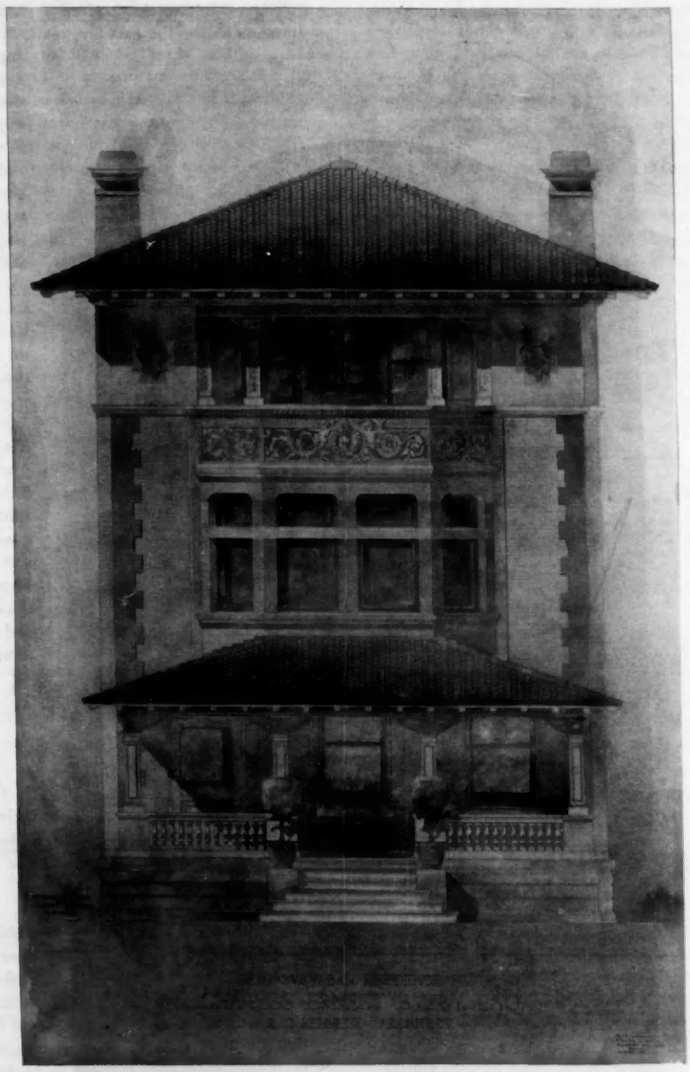
COUNTRY HOUSE AT RINGWOOD, N. J.
Thomas Henry Randall, Architect.

bury, which was hung close to Carrère & Hastings' design, showed a Venetian treatment of buff brick with an elaborate central motive and a crowning story richly worked out apparently in terra-cotta. Collegiate buildings, by the way, seemed to be quite plentiful in the exhibition. Another recitation hall for Vassar, shown by Rossiter & Wright, was a simple, well-studied design, in the style which seems to have come to be accepted as the American Collegiate, a pretty straight adaptation of the best features of the English Tudor Collegiate buildings. Lamb & Rich exhibited their design for Barnard College, New York, a strong, restrained, well-studied effect in brick.

Of a very different kind was the perspective showing the garden and wing to Union League of Philadelphia, Keen & Meade, architects, a strong composition in yellow brick and white stucco, recalling somewhat the feeling of Southern Spain, or Pistoja, with a foreground formed by a simple garden, charmingly arranged, with a fish pond in the center. The drawing, by Hughson Hawley, is a very striking one, both in composition and rendering. It is a pity that it should have been hung so high, and so immediately over one of the partitions of the alcoves that it was hard to get a really fair view of it.

The country house in Maryland, by T. H. Randall, architect, which we publish herewith, is the kind we should be glad to see more of, and it shows that Mr. Randall has studied to excellent advantage the brick country houses of the South. It was a delight to find these straightforward, direct elevation drawings in the midst of highly colored perspectives. After all, though clients demand a perspective, and are easily caught by brilliant coloring or effective if impossible effects of light and shade, the real study is shown on the elevation drawings. Green & Wicks appreciate this, as is evidenced by the happy design for house for Dr. S. W. Putnam, also published herewith, a very successful treatment of a city house.

Mr. Bruce Price exhibited an interesting design for the St. James Office Building, which attracted considerable notice, and which presented a very successful decorative feature in the use of colored brick diaper work. The unfortunate results which accompanied the use of this treatment in the church which formerly stood on the corner of 42d Street and Madison Avenue, which gained for it the designation of the Church of the Holy Oil Cloth, have prevented a fair recognition of the effectiveness of this method of decorating a wall surface, and it is encouraging to see that some of our best architects are returning to this perfectly legitimate system of color treatment. Mr. Price also exhibited a large drawing of Mr. George Gould's house at Lakewood.



RESIDENCE OF CHAS. E. BUZBY, ESQ.
R. G. Kennedy, Architect; Kennedy, Hays & Kelsey, Philadelphia.

The office buildings exhibited were less distinctively of brick and terra-cotta, though there was Walker & Morris's design for the Washington Life Insurance Company Building, in brick and terra-cotta, and the proposed Woman's Hotel, by Gannon & Hands, in buff, or old gold brick and light terra-cotta (?), the drawing of which was very strong in tone with a color effect helped out by the banners at top of the building.

A building we should have liked to see illustrated to better advantage was the new Astor Hotel, Fifth Avenue, adjoining the Waldorf, both by Mr. H. J. Hardenberg. The combined Fifth Avenue fronts were shown on a single highly rendered elevation, the scale of which was, however, too small to do justice to the beautifully designed and executed terra-cotta details. The 35th Street front of the Astor Hotel is an especially good example of the best and most recent adaptation of terra-cotta and brick. The new Delmonico, by James Brown Lord, is another building presumably in brick and terra-cotta which was tantalizingly suggested rather than shown by a large rendered drawing in full color.

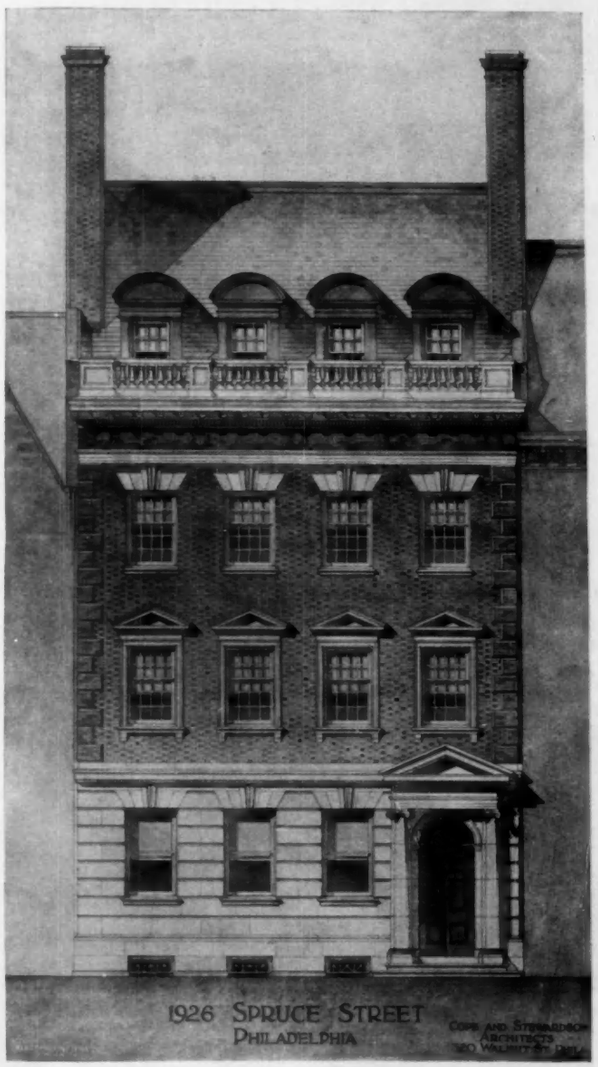
Philadelphia was well represented. Cope & Stewardson exhibited a design for a city residence, conventionally treated, in thoroughly good taste, well balanced and exquisitely proportioned. This was indicated as in red brick with white trimmings. After all, there is a good deal of satisfaction in being able to revert to a type and polish away on that type until the proper degree of finish is attained. Wilson Eyre, Jr., contributed one of his charming studies, designated as "A Design for a Broker's Office." Mr. Eyre is so unique in his style, and his work has such a delightful personal quality, it is always anticipated with pleasure. The drawing seemed to indicate purple-black brick. It is quaint, jolly, convivial, representing just the sort of structure we would expect some of Howard Pyle's

characters to inhabit, and to issue from with church-warden pipe and bowl of punch for solace. The residence by Mr. R. G. Kennedy is a picturesque, sunny treatment of a city front, one of the few designs exhibited which showed a use of terra-cotta roofing tiles.

Howard & Cauldwell exhibited an interesting drawing for a church at New Brighton, Staten Island, showing a very conscientiously developed design in gray brick and Spanish roof tiles. The brick might be buff or gray, the drawing being graded in different parts. The building is Romanesque in style, recalling some of Vaudremer's work, with large windows on the sides separated by buttresses, diaper work of deep red brick in the spandrels, and the same deep red or orange tones carried out in the tympanum of the door. The door itself was painted on the drawing a bright green, affording a very emphatic contrast, which, however, was warranted by the general result. The plan is a very irregular one, with the tower on the side, and the whole church, while perfectly individual, suggested in arrangement and design S. Pierre de Montrouge, Paris, but without the coldness of the French church.

As a scheme of color treatment may be noted a design for three residences, in a single block, by Marcus T. Reynolds, showing a high basement of rusticated terra-cotta in simple courses, and a perfectly plain brick surface above, the whole in a monotone of gray buff except for streaks of strong red marble used as mullions of the windows of the upper story, adding just enough emphasis to relieve the tones of brick.

Around the central gallery of the exhibition rooms were placed eight terra-cotta columns with Ionic capitals, the whole standing 8 or 10 ft. high and executed in a light-colored buff. The workmanship, while not perfect, was so nearly so as to recall the days, not so very long ago, when such true work with evenly matched flutings and symmetrical entasis would have been impossible in terra-cotta. These columns were set up apparently without any mortar, but seemed to stand perfectly true, and were excellent examples of what can be done with the material.



A CITY RESIDENCE.
Cope & Stewardson, Architects. Rendered by Chas. Z. Klauder.

The exhibition showed by inference our national timidity in the handling of color. When we undertake to indicate color, we do not, like the Japanese, use real color, but rather make colored pictures, a distinction which will be appreciated by any one who has tried, for his own satisfaction and without any reference to what a client wants or thinks, to study out on paper in advance the actual colors which should be used in a chromatic treatment of a front. It is really a question how far we can to advantage undertake to study in perspective, for if we apply color directly to a perspective without graduations it ceases to have the effect of a picture, and pictures are what clients and exhibitors demand. The real study can to best advantage be put upon the elevation, as is shown by Mr. Price's excellent study of the old house at Lakewood, which is in direct elevation, and from an architectural standpoint shows the building to a great deal better advantage than any perspective could possibly do.

The exhibition emphasized a statement which has frequently been made during the past few years, that architecture is not advancing as rapidly as her sister arts, and that within recent years decoration, sculpture, and the applied arts generally, have developed a wonderful vitality and have made rapid strides in every direction, while in architecture we seem to be making way for our artistic craftsmen and perfecting our own art by its accessories rather than by its intrinsic advance. The exhibition shows the tendencies of our public work far better than the actual work itself would make them manifest, for an architect will very often put himself on record on paper where he would hesitate to carry out the same thought in actual practise, and consequently an exhibition of this sort is better able to measure what the architects want to do than if we should go around and see what the same architects were actually doing.

PERSONAL AND CLUB NEWS.

MESSRS. SHEPLEY, RUTAN & COOLIDGE have removed their Chicago office to the Old Colony Building, Dearborn and Van Buren Streets.

CLEVERDON & PUTZEL, architects, New York City, have removed their office from 13 Astor Place to the Hartford Building, Union Square.

H. E. BOUITZ, architect, having opened an office at Wilmington, N. C, would be glad to receive catalogues and samples of building materials.

ON the evening of April 19, Mr. Peter B. Wight, architect, delivered an address before the Chicago Architectural Club on the "Fundamentals of the Development of Style."

THE ART INSTITUTE of Chicago has invited the Chicago Architectural Club to make its home within the Institute Building. Aside from the desirable location, the club will have special privileges in connection with the Art Institute.

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE twenty-six Ionic columns used on the Hoffman Library, and referred to in a preceding chapter (Fig. 6, page 8), were, we believe, originally intended to carry an entablature and two pediments in the same material. It was afterwards proposed to substitute metal, and this, we regret to say, was ultimately done in the building shown at Fig. 7. If the wisdom that is said to repose in "sober second thought" be open to exceptions, we think that the latter determination should count as one of them. Had the original intention been adhered to, it could have been executed without serious difficulty, and a scheme of construction such as that shown at Fig. 19 might have been adopted with confidence as to the result. This particular cornice is, of course, an incident beyond recall, and we refer to it merely as an abstract proposition, which will serve as a convenient illustration of what may be done in terra-cotta under similar conditions. The methods employed have a wide range of adaptability, and are open to whatever modification may be found necessary or desirable under other circumstances. It will be noticed that in point of detail our design does not differ materially from well-known classical examples, while the construction has been modernized to date of writing, and made not only practicable in terra-cotta, but quite simple of execution.

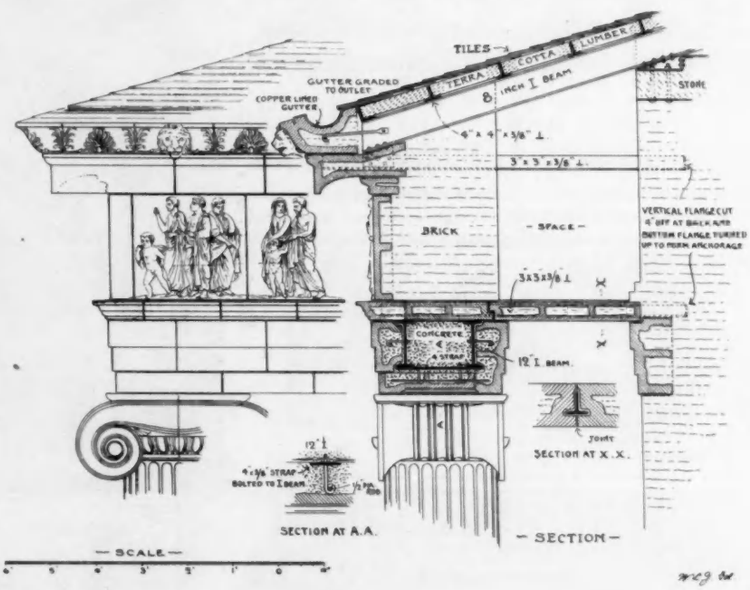


FIG. 19.

The two 12 in. continuous I beams constitute the principal support between columns, and will be found ample for the load resting upon them. To the bottom flanges is bolted a series of straps, at intervals equal to the length of the pieces of terra-cotta, and from these straps the blocks forming soffit of architrave are suspended. While these blocks were being pressed they would be made to receive a rod of ½ in. round iron, which, being inserted from the back, would pass through the partitions without penetrating the finished face. Two hangers would then grip this bar as at section *A.A.*, and passing through holes in the strap would be adjusted by tension nuts until perfect alignment was obtained in the soffit. Similar provision would be made for rods in the blocks forming upper portion of architrave, and they in turn would be bolted to I beams through holes previously located, making it possible to have all punching done at the mill, for greater convenience and economy. These rods should be a trifle shorter than the blocks into which they are inserted; all cavities being then filled with cement, each piece is ready for being bedded solidly against I beams, carefully adjusted at the joints, and tightened up to line by means of nut on the inside. Separators should be introduced between the I beams to give greater rigidity, and to prevent any tendency to spread or buckle. The whole of the space between beams should then be filled with concrete, special care being taken to grout down into chambers showing on top bed of soffit blocks, also around and between the straps until every crevice has been filled. These blocks, being now embedded into a concrete core, would no longer depend for support upon the hangers, which, however, would be allowed to remain undisturbed as an extra margin of safety.

We are aware that work of the kind contemplated in this last item is frequently forgotten, or done (if done at all) in a very perfunctory manner. It would therefore require close supervision to ensure its being done uniformly and thoroughly. But, assuming that a reliable brand of cement has been used, and that conscience, as well as the requisite amount of skill, has been put into the work, we would in this way obtain a terra-cotta architrave of composite construction that would be stronger, and perhaps more durable, than a monolith in stone of corresponding section. Cement is an excellent preservative of iron, and the interior skeleton being completely protected from the effects of fire and water, there would be little to fear in the line of deterioration or discoloration from rust.

The inverted tee of light section at *X.X.* would be inserted in joints of ashlar ceiling, which would be made in slabs of convenient length. This has no weight to carry, but it, too, should have its chambers filled, and the top bed floated in cement. Another inverted tee would be inserted at every joint in lower member of cornice, and should extend back some distance into main wall. These cantilevers would carry the direct weight of the top member of cornice, which, having been set to line, should be securely anchored back to roof; the hooks taking hold of a rod, for which provision would be made, as in the case of architrave. In backing up the frieze, the bricks should be built into the chambers of every block; and if this is done, no additional anchors would be required.

The frieze and tympana may, of course, be finished in plain ashlar, where a simple or severe treatment is considered preferable. But in most instances the plasticity of them aterial would, no doubt, furnish tempting inducements for the introduction of allegorical subjects, suggested by and befitting the character of the building. The jointing of the actual work would be much less conspicuous than it has been made to appear in the drawing, in which, as in previous examples, the joints have been intentionally exaggerated. None of these drawings were prepared with any view to pictorial effect. Their primary object is not to clothe or conceal, but to dissect and exhibit the anatomy of the subject. The aim is to show as clearly as possible the exact relationship which one block bears to another, and on what the whole of them must ultimately depend for support. For the same reason we have selected this particular subject, because it embraces in a comparatively small compass a number of the chief difficulties usually met with in work of a similar character. Granted that we are not called upon to duplicate a Greek temple every day, the fact remains that such a thing could be done very successfully. The system of composite construction now proposed does not differ

in principle from that which has frequently been tested on a smaller scale in actual practise. The example before us merely calls for its extension under favorable conditions.

In almost every phase of modern Renaissance work troublesome problems of the same kind are frequently encountered, and, whether we like it or no, have to be met by the adoption of similar expedients. Nearly all the latest and best work is but a free adaptation of classical forms, with very often a literal application of classical detail.

The actual construction of an entablature such as that to which we have just referred is shown in Fig. 20, It was adopted in the erection of the new City Hall, Elmira, N. Y., and when submitted to a practical test was found to work admirably. If any doubt had existed on the point, it would have been set at rest by the very reassuring reply just to hand from the architects, to whom we are likewise indebted for a confirmatory photograph, showing this portion of the building at Fig. 21.* In answer to a

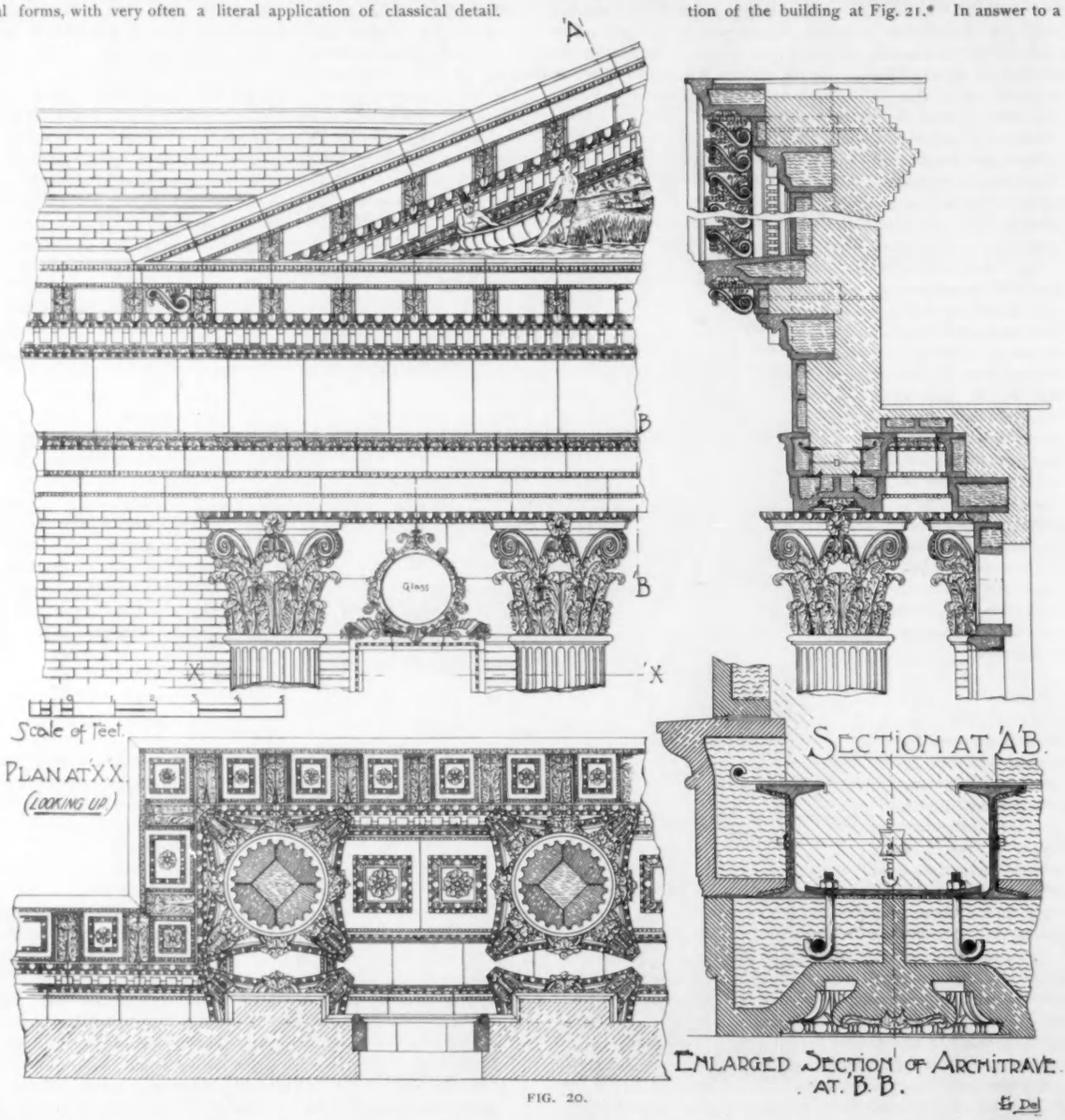


FIG. 20.

Wherever the architrave, frieze, and cornice becomes part of a design, certain portions of it have, at times, to depend upon some form of invisible support. So long as the architrave rests directly on a wall, the making and setting of the work remains a simple affair indeed. But when it has to be carried across openings of considerable extent, between piers, columns, or pilasters, the problem is to all intents the same as the one now in question. In such cases, the solution usually resolves itself into an iron core of sufficient strength, to which is attached a terra-cotta casing.

specific inquiry on this subject, they write: "In regard to the construction of the terra-cotta, and the manner of supporting it, we would say that we cannot suggest any improvement on the method adopted. It has answered the purpose perfectly, and no settlements

*The scope of our remarks is at present restricted to a somewhat narrow, but very necessary phase of terra-cotta construction. It precludes, for the time being, a more general review of this highly creditable example of municipal architecture. We propose reverting to this building (among others) at a later date; by which time its completion, and the removal of temporary enclosures, will permit of more adequate photographic illustration.

or cracks have developed since the work was finished." In this particular case the soffit was made in single blocks, with a panel and rosette in the center of each, and the joint passing through the center of rail. This allowed the iron rods to be inserted longitudinally, passing clear through the ends and partitions of the block. Separators, bolted at intervals between the I beams, prevent lateral deflection and thereby greatly increase their rigidity. Being held at a uniform distance apart, the flat bars (through which the hangers pass) may be placed where required during the setting, as they merely rest on the bottom flange of each beam and do not need any other fastening.

We cannot be too emphatic in urging the use of cement filling in all work of this kind, and that for the reasons given in speaking of Fig. 19. It has already been spoken of as a good preservative of iron, which it undoubtedly is; but in saying this two conditions are implied which cannot always be had for the asking. To be effectual,

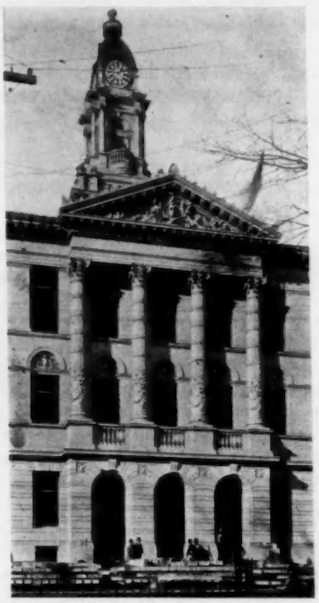


FIG. 21.

the iron should be entirely sealed up in the cement, and it must be well protected from moisture. If allowed to corrode, it then becomes merely a question of time when something must give way. But long before that could happen, the terra-cotta is liable to suffer irreparable discoloration from iron stains. A solution of rust will find its way to the surface, and if accelerated by damp will soon trickle down through joints of soffit, in work such as that to which we are now giving attention.

We think the best way to prevent such an occurrence is for the architect to anticipate it in his specification. This he can do by directing that all bolts, cramps, anchors, etc., coming into direct contact with terra-cotta, be *galvanized*. In much of the work of past ages which we profess to admire, and (in a superficial way) seek to imitate, the cramps and anchors were often made of copper. Similar precautions against oxidation are sometimes adopted in modern work, but the tendency of the times is against burying anything of intrinsic value in places where it will not "show for all it is worth." A deposit of zinc on the surface of the iron usually reaches the limit of allowable expenditure in this direction. It may, however, be trusted to protect the smaller appliances, and with two coats of metallic paint on the larger sections, no serious consequences are likely to ensue.

(*To be continued.*)

Fire-proofing Department.

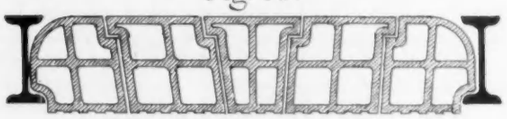
ORIGIN AND HISTORY OF HOLLOW TILE FIRE-PROOF FLOOR CONSTRUCTION.

BY PETER B. WIGHT.

(*Continued from March Number.*)

RESUMING our historical narrative, we find in Edward Dobson's "Rudimentary Treatise on the Manufacture of Bricks and Tiles," printed in London, 1868, a description and illustration of hollow brick construction used in H. R. H. Prince Albert's model houses. These arches were segmental in form, and used to span

Fig. 10.

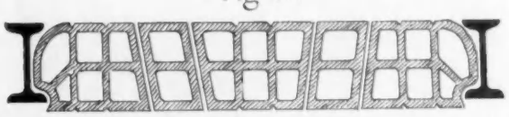


From drawing attached to Roux Frères' Fr. Patent, Mar. 25, 1868.

entire rooms 10 ft. 4 ins. wide. The external springers were of cast iron, built in the brick walls, and connected by wrought iron tie-rods. This construction so much resembles the Bunnett arch that it is hardly necessary to reproduce the illustration. Its main difference is that the joints are straight, and side pressure tiles only were used. The rise of the arch was also greater than in Bunnett's, so that the tie-rods were exposed.

We now come to the invention of Roux Frères, which soon followed that of Garcin. They were manufacturers of all kinds of tiles and hollow bricks at St. Henry, Marseilles, France, and pat-

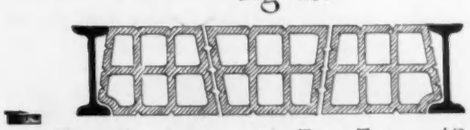
Fig. 11.



ented a flat hollow tile floor and ceiling arch on the twenty-fifth of March, 1868. Fig. 10 is a copy of the drawing attached to their patent.

Their invention was of the nature of an improvement on that of Garcin. They placed alternate notches and ledges at the upper corners of their tiles. They also brought the soffits of the voussoirs below the bottoms of the I beams, so as to allow a thickness of cement between the heels of the springers and covering the bottoms of the beams. This kind of tile was the same that was first made in the United States of burned clay, about 1872, but they were much heavier. The first tile ever made in the United States as light as those of Roux Frères were those of the Wight Fire-

Fig. 12.



From Circular issued by Roux Frères. 1868.

Proofing Company, made in Ohio, in 1881, for the Montauk Block at Chicago. The burned clay body was only ½ in. in thickness, yet the New Jersey manufacturers continued to make much heavier arch tiles for many years after that time.

In a circular issued by Roux Frères, in 1868, are illustrations of two other forms of flat hollow tile arches, which are shown in Figs. 11 and 12.

The first is a flat arch, very similar to that described in the

patent; but it will be noticed that the lugs and recesses at the upper corners of the tiles have already been omitted. The second is a construction in which three keys are used to form an arch, a method which has been frequently used by American contractors

Fig. 13.

From drawing attached to Johnson and Kreischer Patent. Mar. 21 1871

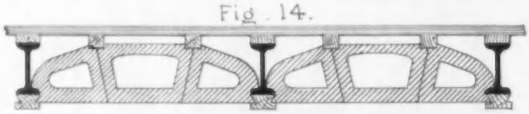
where the beams were very close together. The same circular shows many other interesting forms of hollow tiles for fire-proofing purposes.

We have now reached a point of time which is still nearly thirty years back, and find that then flat hollow tile floor arches were invented in all particulars except the use of tiles under the I beams. Naturally, there are no more records of French patents; but in the United States there was a lapse of three years before any patents appeared.

The first was that of George H. Johnson and Balthazar Kreischer, dated March 21, 1871. Fig. 13 is a copy of the drawing attached to this patent, and Fig. 14 is a copy of the drawing attached to a patent granted to Balthazar Kreischer alone on the same day, and bearing a number only four greater than that of the partnership patent.

The curious nature of this sequence of invention is obvious without explanation, and forms an illustration of some of the strange methods of inventors and what can be accomplished through the Patent Office; but the sequel shows that neither inventor ever received any benefit, unless it may have been from the sale of the patents. It

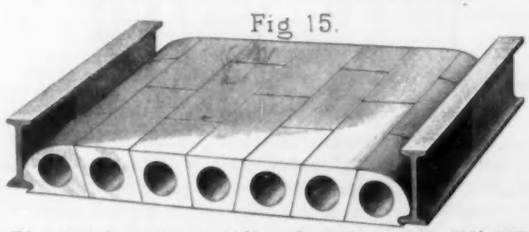
Fig. 14.



From drawing attached to Balthasar Kreischer Patent. Mar 21.1871.

was evident, and the records of the Patent Office show that the form of arch in the first patent had been anticipated by the Peterson and Abord patents, and that the division of the arch tile into three parts had been anticipated by many English and French inventions. So the office recognized invention by only allowing claims in the Johnson and Kreischer patent; first, for the recesses on top to hold the wooden floor strips; and second, "The removable clay filling strips, D, in combination, etc., etc., . . . for the purpose specified," the only purpose specified in the description being "a good finish to the ceiling." The part enacted by the last claim will be referred to hereafter. The only claim allowed in the Kreischer patent was for making the arch tile in three pieces. This patent was reissued Dec. 3, 1872, with two claims substantially the same, but the number of pieces is not stated. In the drawing attached to the Kreischer patent (Fig. 14), the strips under the beams are cross-sectioned like the

Fig. 15.



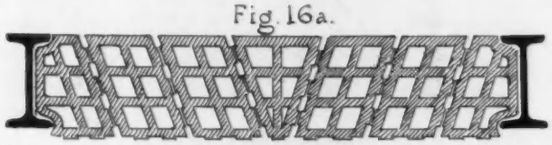
Flat Arch from circular of Heuvelman, Haven & Co. N.Y. 1873.

floor strips, as if of wood, but are not referred to in the description or claims. When this patent was under fire eleven years later in the United States Circuit Court, these strips were always referred to as wooden strips, and this was not disputed.

Flat beam arches of hollow tile were manufactured in 1872 and 1873 in this country, and I believe that these were the first in which voussoirs of burned clay were used in America. They were employed in the floors over the outer corridors of the New York post-office, in the Kendall Building, Chicago, and in the Singer Manufacturing Company's building, at St. Louis, and a few others. Fig. 15, taken from a circular of Huvelman, Haven & Co., of New York, who were licensees under the Balthazar Kreischer patent, shows what these arches were.

About the same time flat hollow arches were made at New York by the Fire-proof Building Company of that city, which was organized to introduce French methods of construction for fire-proofing purposes in this country, the company controlling certain process patents for using cement and plaster. But they do not concern this historical review, which is intended to cover only manufactures in clay, except as throwing side lights upon constructive methods. The methods

Fig. 16a.

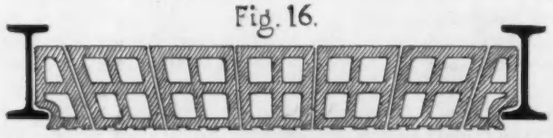


Flat Arch made by Henry Maurer. N.Y. 1875.

employed in building fire-proof floors followed mainly those of Garcin and Roux, but the material was French cement, plaster, and coke breeze. These received great favor from architects at the seaboard cities, mainly on account of the confidence reposed in the scientific attainments of Leonard H. Beckwith, who was at the head of the enterprise. But at the same time the late A. H. Piequenard, architect of the new Illinois State capitol at Springfield, introduced the Garcin and Roux systems into that building, using only plaster and cinders in making the hollow blocks. These he also had seen in France, and such floor construction was used generally in the upper floors of the capitol.

The Fire-proof Building Company of New York commenced to use flat hollow arches made of burned clay in their contracts on the Coal and Iron Exchange and Tribune Buildings in that city in 1874. The avowed object at the time was that they would be better than cement in hallways and rooms which were to be finished with encaustic tile floors. The following section shows the system of

Fig. 16.



Flat Arch made by Fire Proof Building Co. N.Y. 1874

floor arch built at that time, and very similar ones are even now employed (Figs. 16, 16 a).

Flat arches of essentially the same section were soon after made and sold by other manufacturers of fire-clay goods, located in New Jersey and Staten Island, notably Henry Maurer and the Raritan Porous and Hollow Brick Company.

It was many years after the Kendall Building was constructed at Chicago before any more hollow tile arches were used in that city. About the year 1878 they were used for all the floors of the new Court House, having been manufactured in Ohio. They were made of common clay, straight at top and bottom, rather crude in form of voussoirs, and without interior webs. When the City Hall adjoining the Court House was built a few years later, hollow tile floor arches were used. They were flat on the soffit, and arched at the top, and

were without interior webs. These were manufactured at Utica, Ill., for the Ottawa Tile Company, now the Pioneer Fire-Proof Construction Company.

There was little or no change in the form of flat floor arches used in the seaboard States before 1885, but they were extensively employed for nearly all buildings in which iron beams were used.

In 1882, the Montauk Block was built at Chicago, being the first of the distinctively high office buildings of that city. The architects were Burnham & Root, and the writer was consulting architect up to the time that the company of which he had just become the general manager was awarded the contract for the fire-proofing. This building signalizes several departures in construction which are historic. It was the first in which iron rails were used in combination with concrete in the foundations, the account of which has heretofore been described in THE BRICKBUILDER, and the first in which the walls of an adjoining building were supported on adjusting screws during its construction and settlement. The original intention was to construct the floors of iron rails and concrete, similar to the Southern Hotel at St. Louis; but this was abandoned and 6 in. I beams were substituted in most of the floors, while 8 in. I beams were used in some parts where necessary. The spacings between the beams were consequently narrow. The floor arches used were of the section here shown (Fig. 17).

The main object sought was the least weight consistent with requisite strength. These arches weighed only 25 lbs. per superficial foot. Diagonal webs were introduced in the skew-backs, and vertical webs in the skew-backs and wide keys. The material was reduced to a thickness of half an inch. This was only possible by using great pressure. In addition to this I determined to make them of pure fire-clay. They were therefore made on a vertical sewer pipe press, and I believe that they were the first tiles ever made to demonstrate how the weight of floor arches could be reduced to the minimum, at the same time using fire-clay. Before this, the only floor arches made of fire-clay had been those for the City Hall, but the walls were all ¾ in. thick. Up to this time the weight of hollow tile floor arches had been little considered in this country, and no thought had been given to the importance of using fire-clay outside of Chicago, any refuse clay, worthless for other purposes, being considered good enough. The development of the business became rapid in the Central Western States after this, too rapid to here describe in detail. Two companies were in operation at Chicago, and their imitators soon sprung up in other localities.

Fig. 17

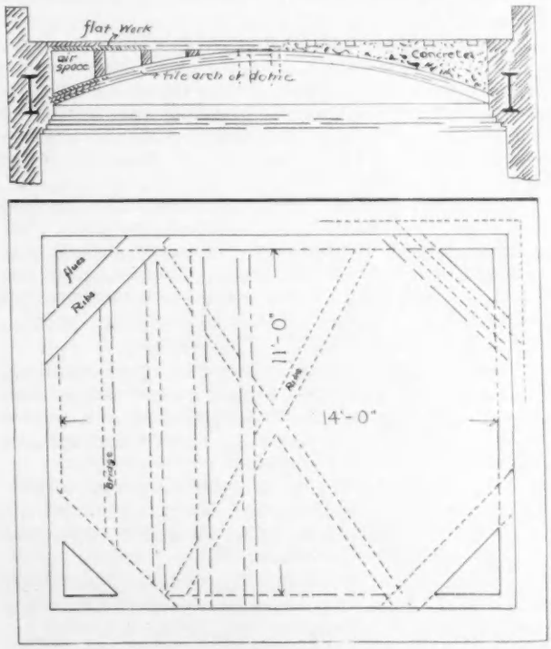
Ordinary Method of covering beams.

The next advance came in the use of porous terra-cotta for floor arches. This valuable material had been employed in Chicago for other fire-proofing purposes as long ago as 1873, and was first used in making roof blocks set between T irons at the Chicago Water Works, and for fire-proofing iron columns in the Mitchell Building at Milwaukee, and the Chicago Club Building. The first use for flat beam arches was in the roof of the old south wing of the Patent Office at Washington. As nearly as I can remember, this was about 1885 or 1886. The north wing had been burned out and restored in a fire-proof manner. Then Congress appropriated a sum to be expended in reconstructing all that part of the original building now called the south wing. The architects were Chiss & Shultz, of Washington. It was found that the whole roof of the pediment would have to be rebuilt, including the attic story and rooms in the same. There was considerable girder, column, and truss work also to be protected. On my suggestion, the architects decided to use only porous terra-cotta. The contract for the roof fell to Henry Maurer, of New York. As continuous flat ceilings were not necessary, and lightness a great desideratum, each of the beams was first covered with porous terra-cotta to about one third of its height from the bottom. Then a flat, hollow, porous terra-cotta arch was sprung from beam to beam flush with their tops, and resting on the porous terra-cotta filling on the sides of the beams. The whole was plastered and hard finished, showing the shapes of the beams.

(To be continued.)

A VERY interesting test was recently made of the Guastavino arch construction. The experiment was conducted at 68th Street and Avenue A, New York, and combined a fire and a weight test. A space 11 by 14 ft. was enclosed by brick walls and covered by an ordinary Guastavino vault laid with three courses of tiles, 3½ ins. thick in all, with a rise of 10 per cent. Over half of the surface of the vault there was laid a concrete filling to a height of 2 ins. above the crown, while the haunches over the other half were built up with ribs or bridges connected by two level courses of tiles, leaving hollow spaces as indicated by the diagram. This was to ascertain whether one construction would be more affected by heat than the other. A fire was built in the chamber under the vault, the gases being carried off through flues at the corners of the rectangle.

The resulting temperature in the combustion chamber varied from 2,000 to 2,500 degs., rising sometimes as high as 2,525 degs. During this time there was a fixed load of 150 lbs. per superficial foot upon the arch. The closest observation did not indicate any deflection due to the load before the fire. During the test the ceiling and the walls rose by expansion one half an inch, and the crown of the vault of one fourth of an inch more. After being exposed to the heat



for five hours, water was thrown on the vault from below, and the fire put out. Through the action of the sudden lowering of temperature when the water was applied, the templet course fell in a few places. When the vault was cooler the deflection of the ceiling was only .22 of an inch, but when the load was removed the vault rose again so the deflection was only .17 of an inch. After this, the load was again applied, and increased until 600 lbs. per superficial foot, something over 50 tons in all, was imposed. The operation of loading took some six hours, during which time the ceiling gradually deflected in the crown to a total deflection of .37 of an inch, remaining in that position thereafter.

The load and the fire were much more severe in this than in any previous test, especially the loading after the fire. There was no perceptible difference in the behavior of the two methods of construction above the vault.

Mortar and Concrete.

AMERICAN CEMENT.

BY URIAH CUMMINGS.

CHAPTER VII.

CEMENT TESTING.

(Continuation of tests made by Prof. Cecil B. Smith.)

ALTHOUGH the utilization of natural cement rock for Portland purposes is not practised to any great extent in Europe, owing, no doubt, to the uneven quality of such rocks, yet in this country more than two thirds of the Portland cement produced is from this source.

Limestone to the extent of 10 to 15 per cent. is added to the cement rock, which, in the section where such Portlands are manufactured, contains an excess of clay.

Portland cements produced in this manner are fully equal in quality to those which are compounded by an artificial admixture of clay and carbonate of lime, and it may be said, in passing, that there are no Portland cements in the world superior to those produced in this country.

The consumer who uses imported brands in preference does so at his own risk, for no manufacturer in Europe guarantees the quality of his cement after it is delivered into this country. The Portland producers here guarantee their product, as do the rock cement manufacturers, and they are here on the ground ready at all times to make good any damage which may be caused by the failure of their cements.

And yet, at the present time, there are three barrels of imported Portland used in this country to one of our home production. Such is prejudice. Still, it is pleasant to note that it is gradually dying out, and it is to be hoped that the time is not far distant when American Portlands will be used in preference to those from other countries.

If we take a few pounds of correctly proportioned cement rock in one piece, and divide it into two equal parts, and designate them as samples No. 1 and No. 2, and take No. 1 and calcine it, and then grind it to powder, we have converted it into a natural hydraulic cement.

If we take sample No. 2 and first grind it to powder, and then calcine it, and again reduce it to powder, we have converted it into a Portland cement. This comprises all the difference in the manufacture of the rock and Portland cements.

Now if we mold these samples separately into briquettes and submit them to a tensile strain test per square inch of cross section, treating them alike as to time in air and in water, it is probable that when tabulated they would appear about as shown in the following table, provided, of course, that both samples had been calcined in accordance with the methods now in vogue by the manufacturers of each class.

TABLE A.

Time.	Lbs. 1 Day.	Lbs. 1 Week.	Lbs. 1 Month.	Lbs. 6 Months.	Lbs. 1 Year.
No. 1	65	125	175	350	500
No. 2	125	400	500	750	1,000

Granting that this table is approximately correct, and we have a large collection of tables gathered from many sources which substantially verify the figures given, what are the conclusions to be drawn therefrom?

If the actual values are to be measured by the pounds in tensile strength which the briquettes are capable of sustaining, and this is the prevailing belief at the present time, and has prevailed during the past thirty-five years, it would seem indisputable that up to one year No. 1 had but one half the value of No. 2.

It is safe to assert that not one engineer or architect in a thousand carries his tests beyond one year.

It is equally safe to assert that not one in a hundred carry tests beyond three months.

It is not difficult then to understand, in the light of the table given, how the prevailing opinion became so firmly established.

The idea that the higher the test the greater the value has come to be firmly fixed in the public opinion as being sound beyond question.

The manufacturer whose cement tests higher than that of his neighbor in a one or thirty day test, wears an air of superiority which is simply indescribable.

It is settled in his mind that his cement is better than that of his neighbor.

And the neighbor who is defeated in the test is correspondingly depressed. He has a feeling akin to that of the speculator in Buffalo, N. Y., who walked across the road to bestow a kick on a certain sleeping omniverous mammal lying in the gutter, because pork had taken a drop in the market that day.

And well may the defeated cement maker feel somewhat depressed, for the chances are ten to one that the engineer who made the tests believes the higher testing brand the better of the two.

It does not follow that the lower testing cement is the better, although it is not impossible, by any means. Neither does it follow that the same results would obtain had some other engineer tested the same brands from the same packages.

But in the table we have another problem to deal with. Here the two classes are made from identically the same material, and the differences in the testing can only be attributable to the different modes of manufacture.

The Portland cement has set much more rapidly than the other during the first year, and it is this fact alone that has brought almost, if not quite, all the cement-making and cement-using world to believe that Portland cement is vastly superior to the rock cement.

The question arises as to whether or not the prevailing opinion is founded on fact. If the answer is confined to the one year's showing, then it must be said that the opinion is sound.

But if the public could be brought to realize that one year is but the beginning of the test, that the real trial is but fairly started, and is on, so long as the work endures, in which the cement is used; if it were understood that after five years not one engineer in a hundred can tell either by simply looking at a wall laid in cement, or by the use of the hammer, whether the cement used was rock or Portland cement, and if it were known that it is a fact, that when we have occasion to blast out old concrete laid in rock cement twenty-five years before, we find it as hard as any rock; and if it were possible for the public to become as familiar with three to five year tests as they are with the prevailing tests, then there would be a remarkable overturning of preconceived notions in regard to cement values, and thinking men to undertake a readjustment of their opinions, for nothing is more certain than that if the samples Nos. 1 and 2 of the table given were carried along in the tests yearly from one year to five, the table A continued, would appear substantially as follows:—

TABLE B.

Time.	2 Years.	3 Years.	4 Years.	5 Years.
No. 1	700	800	900	1,000
No. 2	1,000	800	750	600

The following table of tests was made by C. E. Richards, cement tester on the new Croton Aqueduct at Brewster, N. Y., from American rock cement manufactured by the author.

Briquettes one square inch in cross section, one hour in air, balance of time in water.

No. of Briquette.	Time when Made.	Time when Broken.	Tensile Strength lbs.
1	Oct. 4, 1886.	Nov. 18, 1889.	910
2	Oct. 11, 1886.	Nov. 18, 1889.	860
3	Oct. 11, 1886.	Nov. 18, 1889.	960
4	Nov. 29, 1886.	Nov. 18, 1889.	960
5	Nov. 21, 1886.	Unbroken at 1,000 pounds.	
6	Nov. 30, 1886.	Unbroken at 1,000 pounds.	

The Riehlé 1,000 pound testing machine used.

The following is an extract from "Records of Tests of Cement," made for the Boston Main Drainage Works, 1878–1884, by Eliot C. Clarke, M. Am. Soc. C. E., page 160: —

"The following series of tests may be of interest on account of the age of the specimens. The mortars were made with an English Portland cement, both unsifted as taken from the cask, and also after it had been sifted through the No. 120 sieve, by which process about 35 per cent. of coarse particles were eliminated.

TABLE NO. 12.

BRIQUETTES 1 SQUARE INCH CROSS SECTION.

Kind of Cement.	Neat Cement.		Cement 1. Sand 2.		Cement 1. Sand 5.	
	2 Years.	4 Years.	2 Years.	4 Years.	2 Years.	4 Years.
Ordinary cement unsifted.	603	387	339	493	182	202
Cement which passed No. 120 sieve.	374	211	478	580	250	284

"This table also shows that fine cements do not give as high results, tested neat, as do cements containing coarse particles, even coarse particles of sand. It also shows (what is often noticed) that neat cements become brittle with age, and are apt to fly into pieces under comparatively light loads."

It cannot be denied that at five years artificial cements are extremely brittle, and briquettes made from this class of cements, if let fall on a stone floor, after they are four or five years old, will fly into as many pieces as would a glass bottle falling from the same height, and this is not true of the better quality of rock cements.

But engineers tell us that they cannot wait five years, or five months even, to learn whether a cement is good or bad, which is true enough, but does not alter the facts in the case; and the facts are that very high short-time tests are unfailing evidences of subsequent weakness.

These facts are demonstrated in every table wherein the tests have been carried from one day to five years, that has ever come under the observation of the author.

The following is an extract from a lecture delivered by the author before the Society of Arts of the Massachusetts Institute of Technology, Boston, November, 1887: —

"The testing machine reveals many curious freaks, and taken on the principle that "everything is for the best," it may yet reveal to us that a cement may test too high, that this modern demand for high testing cement, and the tremendous struggle on the part of the Portland cement manufacturers to supply it, striving by every conceivable means to beat the record, is all wrong.

"This may sound strangely at first, but a study of the tables of long-time tests of Portland cements, as compiled by such engineers as Clarke, of Boston, and MacClay, of New York, and others eminent in the profession, reveals the rather startling fact that briquettes of neat Portland do not test as high at three or four years as they do at one or two years old. Clarke says: —

"'They become brittle with age and are apt to fly into pieces under comparatively light loads.'

"If this is the result with neat cement at that age, what is to prevent the same results with sand mixtures at fifteen to twenty years or so?

"The ten years' tests of Portland cement, made by Dr. Michaelis, of Berlin, show that the maximum strength was reached at the end of two years, and this point held fairly well until the end of the seventh year; but from that time until the end of the tenth year there was a remarkable falling off in values. We do not recollect ever having seen any table of long-time tests of Portland cement that did not exhibit similar results, and it is more than probable that it may yet be shown that our best natural, slow-setting American cements may, in ten to twelve years' tests, surpass any artificial cements. The excellent condition of some of our old work, done many years ago with American cements, would seem to indicate as much.

"At all events, we have no proof that the Portland is superior in the matter of durability, and we do not believe that clay and lime can be suddenly thrown together, and kept there by any skill of man, that can, in any manner, compare with the staying qualities as found in first-class natural cements, where the clay and lime have existed in the most intimate contact for countless ages."

It is now over nine years since the foregoing was written, and in the meantime the only changes in the views of the author on this subject have been to strengthen rather than to weaken the proposition then advanced.

Years of close observation as to the changes constantly occurring in a cement subsequent to its use in masonry or concrete leads to the inevitable conclusion that a cement which hardens too rapidly in its early stages, whether it may be a natural rock or an artificial cement, should be looked upon with suspicion rather than with approval.

It is patent to every observer who has had occasion to examine briquettes made from both classes, and broken at three to five years, that those which by the records are shown to have tested high in their early stages are at a later period extremely brittle and glassy, and are entirely devoid of that peculiar toughness which characterizes the slower setting varieties.

A cement which attains its limit of tensile strength rapidly will, the moment that limit is reached, commence to become brittle, and from that time on there will be a continual loss in cohesive strength in direct ratio with its increasing brittleness.

Brittleness and weakness are synonymous.

Mr. C. H. Brinsmaid, city cement inspector, City Engineer Department, Minneapolis, Minn., has had twelve years' experience in cement testing in the department named, and has compiled some valuable tables of tests, some brands of Portland running as high as nine years.

In a correspondence with the author, he remarks incidentally: — "Lacking experience, nothing would surprise me more than to see how very brittle these old Portland samples become, and how they snap and fly into fragments by a blow of trowel or hammer. There is no question but that old Portlands are more brittle than rock cements of the same age, however difficult it may be to note the proper comparison."

In Mr. Brinsmaid's tables of neat Portland tests, the figures disclose that three of the leading German and five of the English Portlands reach their limit of strength at one year, after which time they begin to deteriorate, at seven years the German falling to 476 lbs., and the English to 592 lbs.

Referring to the table (A) continued, it is pertinent to repeat the question, "What are the conclusions to be drawn?"

Both No. 1 and No. 2 are produced from identically the same materials and in the same proportions, but No. 1 being a solid rock, and No. 2 a porous mass, they are not affected equally by the same amount of heat, and it is from this cause alone that one hardens much more rapidly than the other, and consequently tests higher in its early stages. But that is no evidence of superiority, notwithstanding public opinion to the contrary.

There are certain classes of work wherein it may be necessary to use the higher testing varieties, such, for example, as sidewalks and similar work, but for heavy foundations and massive masonry, to use

the higher priced cement, simply because it tests higher in short time tests, is expensive folly, for the slower setting variety, or, in other words, the natural rock cements, have been successfully used in the heaviest masonry in the world.

It is well understood that the process of hardening of a cement is simply the crystallization of the silicates, which commences shortly after they have become hydrated by the application of water. Some hydrated silicates crystallize much more rapidly than others.

Rapid crystallization means imperfect crystallization, uneven in size, shape, and texture. In fact, a mere jumble of irregular crystals, and the very rapidity of their formation insures subsequent brittleness and weakness, while those silicates which crystallize slowly form crystals perfect in shape, size, and texture.

Dana, in his "Manual of Geology," page 627, in speaking of the texture of rocks, says: "The grains are coarser the slower the crystallization, or, in other words, the slower the rate of cooling during crystallization; and with rapid cooling, they sometimes disappear altogether, and the material comes out glass instead of stone."

So in the crystallization of the silicates in a cement. If it tests high in its early stages, the breakings of the briquettes disclose the glassy texture, which is quite unlike the stone-like texture exhibited in the slower varieties.

It is possible, then, that the testing machine may yet be the means of convincing the public that a cement may test too high, as stated in the quotation of nine years ago.

The author does not consider it wild or extravagant to assert it as his deliberate opinion that the specifications drawn by the engineer of the future will stipulate that the cement to be used shall not exceed nor fall below a given number of pounds in tensile strength per square inch in cross section at one, seven, thirty, and ninety days.

When that day arrives there will cease this unseemly scramble for high short-time tests. Reason and common sense will prevail, guided by a practical knowledge of the chemistry of cements.

It is not the purpose of the author to disparage or discredit Portland cements, but rather to point out their defects, in the hope that in so doing, more consideration may be given to the subject, and juster conclusions reached.

Unquestionably an ideal hydraulic cement can be produced by what is known as the Portland process, and there is but little doubt it would have been much in use at the present time, had it not been for the unfortunate misinterpretation of the readings of the tensile strain-testing machine in the early stages of its existence.

At the time of its first introduction into England, Portland cements were selling at one shilling per bushel, and rock cements were selling at eighteen pence per bushel.

Such was the public opinion as to the relative values of the two classes of cements sixty-two years after Parker had brought out his Roman (rock) cement, and thirty-four years after Aspdin had produced his artificial (Portland) cement.

Even at the difference in prices, the Roman cement had by far the larger share of the market, and the only means of ascertaining the relative values was by the behavior of the cements in actual work, and making such tests as placing balls of the cement under water.

Then came the tensile strain-testing machine, and it was soon ascertained that the Portland brands tested higher than the Roman cements.

It must have been an important event, an epoch, in fact, in the lives of those engineers, to be confronted with the revelations disclosed by the testing machine.

They had been using both classes of cements, and the rock cements stood, if the price is any criterion, 50 per cent. higher in their estimation than the Portland cements. And yet the testing machine showed them that the Portland cements were the stronger, and so, they reasoned, that if stronger, they must be better. Therefore they had been laboring under a hallucination for, lo, these many years.

Judging by their experience in the use of both classes, the cement which had seemed to them to be the best, that had given them the least trouble, was not the best, after all.

They never questioned the soundness, or rather unsoundness, of their new-found scheme for determining values.

It did not occur to them that the higher testing cement was not necessarily the better cement, and they accepted the result as indisputable.

With their former teachings and experience on the one hand, and the testing machine on the other, the question was not long in doubt. The machine was victorious, and thenceforward all judgment founded on experience was laid aside, and they became blind believers in the tensile strain tests.

What matter though they were continually befogged by the frequent, unreasonable, and capricious pranks of the machine, they had found a god, and were determined to worship it.

And so it came to be established as a fixed belief among engineers and architects that the best cement was the one which tested the highest, and the manufacturer had no alternative but to strive to make his product test as high as possible.

The next step was in the direction of forcing higher tests by using an excess of carbonate of lime, or by adulterations.

(*To be continued.*)

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. II.

BY CLIFFORD RICHARDSON.

CHARACTERISTICS OF GOOD LIME.

PURE calcium oxide consists of 71.4 per cent. of calcium and 28.6 per cent. of oxygen. Its ordinary form is that of a more or less porous earthy white solid which, in a pure condition, is very resistant to heat. It has, as has been shown, a great affinity for moisture and must be preserved out of contact with air from which it absorbs water and carbonic acid.

Caustic lime, for building purposes, should have the following properties: —

Except when made from coarsely crystalline marble, or from marl or shells, it should be in hard lumps.

It should be white, or nearly so, in color. Lime of a yellow or brownish color, with veins of silicious matter, is inferior.

It should be free from semi-fused or fused stone, showing overburning, and from unburnt ash of fuel or clinker.

It should contain less than 10 per cent. of impurities, but often has more.

It should slake rapidly, showing that it is rich and fresh.

Good lime in lumps should weigh, as packed, with about 40 per cent. of voids, 60 lbs. to the cubic foot, 75 lbs. to the bushel, and from 220 to 230 lbs. to the barrel of 3 bushels. If ground or in powder it will weigh less when packed loosely, but when well shaken down it will weigh as much as 270 lbs. to the barrel. A lump of hard lime, 1 ft. cube, would weigh about 95 lbs., having a density of 1.52.

THE SLAKING OF LIME.

Caustic lime combines with water with the evolution of heat to form calcium hydrate. Every 100 parts of caustic lime require 32 parts of water for its conversion into hydrate. If one third of its weight of water is sprinkled on quicklime it becomes very much heated, cracks open, if of the massive variety, swells up and falls to powder. The heat developed is sufficient, at times, to ignite wood. The quicklime becomes slaked lime. This consists of 75.7 per cent. of calcium oxide and 24.3 per cent. of water. It has a specific gravity, when pure, of 2.07. The increase of volume in the process of slaking is due to the formation of steam, which tears the particles of lime apart and expands the mass. If a current of dry steam is passed over heated caustic lime confined in a tube it becomes slaked without any increase of volume.

The smaller the amount of impurities the more energetic is the

act of slaking and the greater the increase of volume. In rich and pure limes the increase of volume under ordinary conditions will be over twice that of the unslaked material, including the voids, while with very poor limes it may be much less. The statement frequently made that lime increases three volumes in slaking is based upon the increase in volume due to the excess of water often used in slaking. In this case it may be as great as 3.4. The amount of increase of volume for the same lime may be very variable, depending on the conditions under which it is slaked. We have seen that it is a reaction between water and caustic lime where much heat is generated, and that to the steam evolved is largely due the expansion of the lime. It is evident, therefore, that the provisions for augmenting and retaining this heat are of importance. If water is added slowly but comparatively little heat is developed, while slaking in an open space will not give as much as when it occurs in a closed box. Cold water also will not accelerate the action as well as warm. The amount of water used has a marked effect on the volume of slaked lime produced. With an equal volume of water the increase for a good, rich lime is from 2 to 2.4. An increase or reduction in the amount of water or in the volume weight of the lime may increase or diminish this.

The following experiment shows the effect of different amounts of water on an ordinary lime.

Volume of Water.	Increase.
½	1.6
1	2.0
2½	2.5
With a poor dolomitic lime the volume increase was only	
2	1.7

It appears, therefore, that the increase of volume to be expected of any lime is dependent on conditions which may be very variable. For example, a peck of lump lime with 44 per cent. of voids between the lumps gave, on slaking with its own volume of water, 2¼ pecks of fine powder of slaked lime, which is a fair increase in volume for lump lime. From 1 peck of closely packed lime, however, 2.5 volumes of slaked lime were obtained. The difference in volume is of course due to the difference in weight of the lime as packed in the two ways.

The proper comparison, therefore, is one of volume from weight. 10 lbs. of caustic lime, for instance, should give 6.8 bushels of slaked lime, an increase of volume of 2.25. Gilmore found in some of his experiments increases as great as 2.46, 2.83, 3.21, 2.40, and 2.14, but the weight of lime in his unit volumes was much greater than occurs in practise, and large amounts of water were used in slaking so that he was dealing with paste instead of dry slaked lime. His experimental results, as compared with our own, are as follows:—

	Rockland. Gilmore.	Roundout. Gilmore.	New York. Richardson.
Weight of lime in lbs.	5	5	5
Volume of lime in c. c.	1557	1806	2350
Volume of water to slake . . .	2983	3300	2000
Increase of weight, per cent. . .	2.24	2.24	1.60
Increase in volume	2.46	2.14	1.91

It will be seen that 5 lbs. of Gilmore's lime occupied a smaller original volume than ours, and an excess of water was used in slaking, which accounts for his results. The theoretical increase in weight should be 1.53 per cent.

General Totten found in experiments on slaking limes no increase in volume greater than 2.27 when no more than an equal volume of water was used. The increase of volume is commonly used as a test of the quality of lime.

AIR SLAKING. Slaked lime is also produced by exposure of caustic lime to the air, from which it absorbs sufficient water to become hydrated, as well as some carbonic acid. This is known as air-slaked lime. It is of little value for mortar making, because there has not been enough heat produced in its formation to tear apart and expand the particles which will alone enable it to form a rich paste. The larger particles have also to a certain extent become hardened on their surfaces by a kind of setting, and by the absorption of carbonic acid from the air.

PRACTISE IN LIME SLAKING. In practise, the slaking of lime for mortar is conducted in several ways. Either sufficient water is sprinkled over the lime to combine with it and resolve it to a powder, providing also an excess for that lost in the form of steam, or an excess is added at once, sufficient to make the finished mortar.

The first method is in some ways the best, because a finer, looser powder is produced, in the manner already described, and because the poorer limes are much more easily and thoroughly slaked in this way with the aid of the greater heat evolved. When too large an amount of water is used the development of heat is prevented, and the operation is much less complete. The particles of lime which are left unslaked go into the mortar in that condition and, being subsequently slowly hydrated by the moisture of the air, expand with injurious effect after it has been used. The popping of mortar, frequently noticed in the walls and ceilings of dwellings, is due to this cause. For the same reason, given above, all the water which is to be used should be added at once or nearly so. If it is added in small portions the effect is to cool down the whole mass and prevent thorough slaking.

We have seen that a third of its weight of water is theoretically necessary for slaking lime. In practise, however, to allow for vaporization as steam, and for the slight excess necessary to bring all the particles in contact with moisture, this amount must be increased to at least an equal weight. It is difficult to say what volume of water should be used, as this depends on the volume weight of the lime, which is variable. It is ordinarily about that of the lime itself plus its voids. Practically it is convenient with fat lime to use two and a half volumes of water, which will suffice for slaking and for the production of a paste. Poor magnesian limes require less.

As heat assists in the expansion of the lime, the operation is best carried on in a covered box. One half of the water is added at first, and as soon as the lime begins to fall to pieces the rest is poured in and thoroughly mixed with the slaking material. The entire mass will thus be raised to a high temperature. The operation thus carried on takes place rapidly, but it can hardly be considered completed until the mass has become cool, or until even after a longer time. In cold weather it is advantageous to use warm water, especially with poor limes.

WATER FOR SLAKING AND MIXING. Water used for slaking lime and making mortar should be pure. When it contains salts, such as chlorides and sulphates, the mortar effloresces and gives rise to stains. For this reason sea water is unsuitable, although it has been used successfully with hydraulic cement.

LIME PASTE OR CREAM.

The lime paste made in the manner previously described may be too stiff for mortar if a very rich lime has been used, or if a very large volume of sand is to be employed in making the mortar. There is no difficulty in thinning it, however, to the proper consistency, depending on the character of the mortar to be made. If, however, more than two and a half volumes of water are added to the lime at first the resulting paste will have a tendency to be granular and to contain lumps which, in the thin cream, it is impossible to break up. In careless practise as much as three or four volumes of water are sometimes used in slaking lime, when it is intended to make a mortar with a large volume of sand. Stretching the cream in this manner to make a small amount of lime fill a large volume of sand voids makes the resulting mortar very porous when dry.

Good paste of lime should not contain at the extreme more than three volumes of water as compared to the measured volume of the quicklime.

As there are generally some hard and unslaked particles even in the best limes, the cream should be run through a sieve if possible, after standing over night, before mixing it with the sand. It should be remembered that the longer the paste stands before use the smoother it becomes. As will be seen later, this improvement goes on after the mortar has been mixed.

The Masons' Department.

THE ARCHITECT AND CONTRACTOR.—(*Continued.*)

BY THOMAS A. FOX.

THE LOWEST BIDDER.

THE recent controversy between the mayor of Boston and the Master Builders' Association of the same city, regarding the award of the contract for building a public bath house, although carried so far as to become merely a war of words, has nevertheless raised several questions of importance to all persons interested directly or indirectly in the building business. The simple facts of the case are as follows: The city advertised for bids on a bath house, and the contract for the work stated that preference would be given to "union labor." The bids were opened and taken under advisement, as is customary, but after the usual time allowed for the examination of the proposals had elapsed, instead of awarding the contract to the lowest bidder, it was given to the second lowest, whose figure was some three hundred dollars higher. This action at once aroused the indignation of the Master Builders' Association, one of whose missions is to guard the interests of the lowest bidder, providing his qualifications for the performance of the work are unquestioned, and the mayor was at once asked to explain the reasons for such discrimination. The reply was made that as the labor unions had taken special interest in this particular scheme, it was thought desirable to have, so far as possible, only union labor employed on the work, and that the contract had been awarded to the concern which was known to employ this class of help. Subsequent correspondence, however, brought out the fact that the lowest bidders employed union labor as well as those who had received the award, and the mayor's action in the end seemed to be justified only by the right which is always reserved to reject any or all bids, should it be for the interest of the city so to do, which doubtless justified the transaction from the legal, but not necessarily from the moral point of view. As almost all of the labor unions of the city have since passed resolutions indorsing the mayor's action, the motive in this particular instance seems to be apparent. Although the incident in itself is of no great importance, there are several principles involved which justify a brief consideration. First, as to the advisability of awarding public work to any but the lowest bidder, providing he is responsible. While in many instances it would undoubtedly be for the interest, both of the public and the architect, to discriminate in the awarding of such work, nevertheless, where contracts are thrown open to general competition, as is usually required by law, it is establishing a dangerous precedent to permit the work to be given to any but the lowest bidder, unless he may be proved irresponsible, and the amount of difference between the bids should have no bearing whatsoever in the case, as it was intimated was the fact in the instance above noted. The difference of a dollar, under these conditions, should be respected just as much as a difference of a thousand or more.

If discrimination in the award of contracts for public work is to be permitted at all, it should be done by allowing the architect, or other qualified person or persons, to select a certain limited number of contractors to figure the work, thus preventing the work being placed upon the open market, and the consequent liability of being obliged to accept an inferior grade of work; but where this method is employed the rights of the lowest bidder should always be respected, as well as under an open competition.

The award of this bath-house contract, moreover, shows the labor unions in rather a new rôle. It is true they have for some time been asking for various forms of legislation in their behalf, and have appeared in politics to a considerable extent, but this is one of the first instances where they have requested or gained favoritism in the award of a building contract. But this step is only following some of the numerous examples which we have constantly before us, in the direction of asking the government to do something for somebody for no valid or particular reason, a policy which, if not checked and rooted out, will soon prove, if it is not already, a serious menace to our republican institutions. There is no ground on which a labor union can ask for preference in the awarding of contracts for public work, unless it may be for the same reason that such organizations as our largest trust and most extensive monopoly receive aid from the native government, which is, of course, no reason at all, and the sooner such things are stopped the better. The evils of special legislation and class preference are in direct antagonism to the spirit of republican institutions, and admit of no argument. The example in such directions is set by those who ought to know better, but whose avarice and greed overcome their rather shallow ideas of justice and honesty. Who can wonder that such example is blindly followed by those who see the government being used to bolster and enrich private individuals and corporations, and from this spectacle gather the impression which soon becomes conviction, that legislation is the panacea for all ills?

It was intimated during the controversy regarding the award of this contract, that one of the reasons for giving a preference to union labor was that it would insure better work, which is at best a most doubtful statement, for the simple reason that most unions are run to help the poorest rather than the best men, a principle which, being in direct violation of one of the fundamental laws of nature, namely, "the survival of the fittest," is bound in the end to fail. The truth is that the management of the great majority of unions is in the hands of incompetent men, those who like to talk but not to work, and very often a man who is too poor a workman to earn a day's wages at his trade is found high up in the councils of the union, or an active member of the board of walking delegates. It is certainly a fact that at the present time union labor insures no better work than the average, and there is consequently no just reason for discrimination in their favor under the impression that superior results will be thereby obtained. No one who has followed the work of the labor organizations can deny that in many ways their work has been beneficial and progressive but in this matter they have shown as they too often do their weakest side. The award of the contract for this building and the controversy which followed it have certainly raised several novel questions, and it will be interesting for all those who are concerned in such matters to watch the future developments, for the affair has raised several interesting points which will take time and further experience to decide.

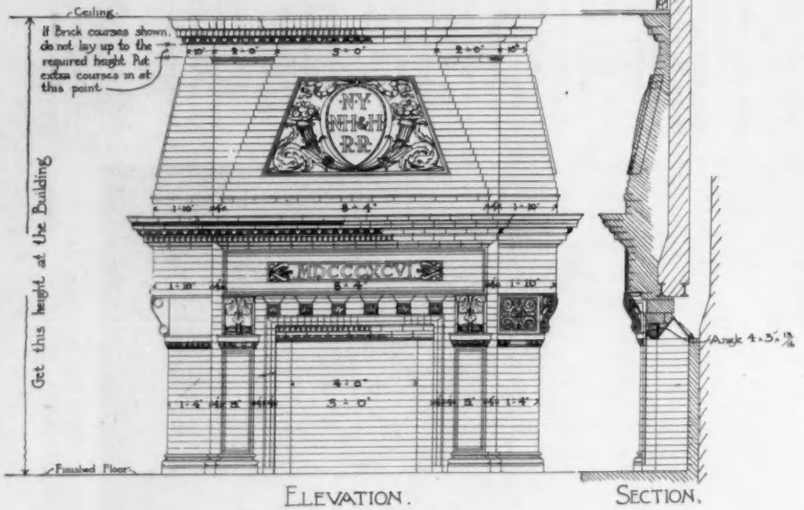
HEIGHT OF FACTORY CHIMNEYS.

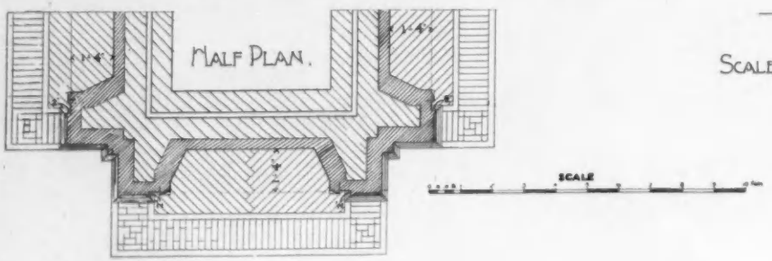
THE notion that the greater the height of a chimney for a boiler plant the greater will be its draught-producing power is responsible for the existence of many chimneys of imposing size, and, at the same time, unnecessary expense. A very tall chimney, well proportioned and gracefully outlined, may be a striking architectural adjunct to a factory, but it is also one that costs considerable money without doing any measurable amount of good. Where chimneys are intended to carry off noxious fumes from chemical works, there is, of course, some method in providing for unusual height, since the aim in such a case is to insure as complete as possible a diffusion of the vapors and prevent their mingling with the air of the lower strata; but for boilers simply unusual height, as stated, is rarely based upon a good reason.

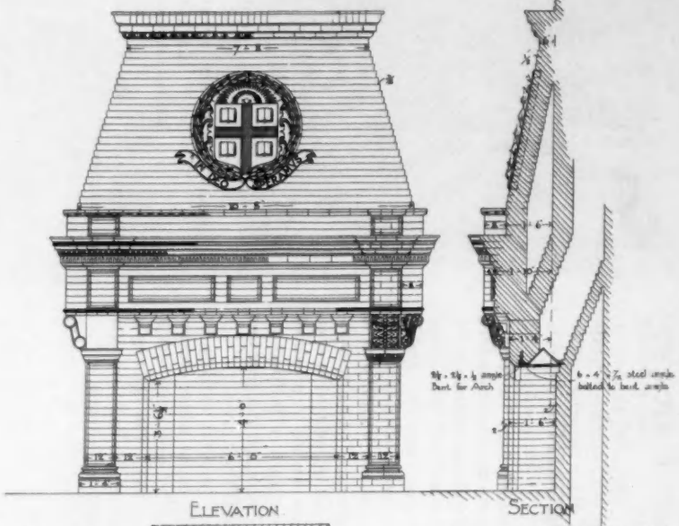
As a matter of fact, the draught-producing capacities of chimneys having flues of the same size are in proportion to the square roots of their heights, so that if one were to have double the power, if it may be so called, of the other, it would have to be four times as high, and not merely twice as high, as many would suppose. A height of 150 feet may be considered, on good authority, as the maximum necessary in any case for producing the requisite draught, providing, of course, that the area of the flue has been properly proportioned. This latter should be made to bear a pretty nearly direct ratio to the combined areas of the boiler flues connecting with it. A chimney much beyond 150 feet is generally suggestive of misspent money.—*Cassier's Magazine for August.*

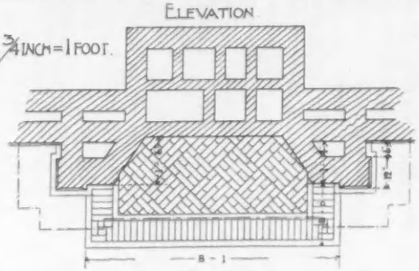
MANTELS IN THE RESTAURANT OF PASSENGER STATION PROVIDENCE, R. I. FOR THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD

200


Ceiling
If Brick courses shown, do not lay up to the required height. Put extra courses in at this point
Get this height at the Building
Finished Floor
N.Y. N.H. & H. R.R.
MDCCCXCVI
Angle 4 x 3½
ELEVATION.
SECTION.







DETAILS OF BRICK MANTELS IN THE THIRD STORY OF THE RECITATION HALL WOMENS COLLEGE. BROWN UNIVERSITY

November 17 1896

STONE, CARPENTER AND WILLSON ARCHITECTS

49 Westminster St. Providence, R. I.

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK.—During the past month there has been a decrease in the number of plans for large and important buildings which have been filed with the building department, but there has been a decided increase in the number of contemplated dwellings and apartment houses, both city and suburban. This is the best possible indication of gradually restored confidence and the passing of "hard times." Business men will risk a great deal of money at almost any time when a large return seems assured to them, but the luxury of a new dwelling house cannot be indulged in when the future is uncertain. One unfortunate instance of misplaced confidence has been brought to our notice this week in the Syndicate Building, sold for the third time within two years, and at a great loss to its original owners, injured to a great extent by its name.

A very interesting new building is the Telephone Building, on Dey Street, just completed. It has a very refined Italian Renaissance façade, constructed entirely of blocks of terra-cotta, with a great deal of elaborate detail beautifully executed. This building is so successful that a great many are of the opinion that terra-cotta will be largely used in place of stone for facing in the future.

Great changes will be made this month on lower Broadway to make room for the many new office buildings, as announced in our last number. Many old landmarks will have to go; one particularly

TERRA-COTTA FRIEZE, ENTRANCE TO STANDARD BUILDING, CLEVELAND, OHIO.
Made by Northwestern Terra-Cotta Company.

interesting, as it is the last residence remaining on Broadway in what was once a fashionable section, the handsome building corner of 19th Street, known for generations as the Geolet Mansion. It will be destroyed to make way for an eight-story brick store and loft building, to be erected by Almy & Gallatin, from plans by J. B. Snook & Sons, architects.

Another sky-scraper is to be erected overlooking Battery Park. R. A. and W. H. Cheseborough have filed plans for a fifteen-story brick office building, to cost $200,000. To be erected from plans by Clinton & Russell, at the southeast corner of State and Pearl Streets, opposite the present six-story Cheseborough Building.

J. C. Lyons has filed plans for a twelve-story brick store and loft building, to cost $800,000, to be erected at Nos. 294 and 296 Broadway, extending to Manhattan Place. Buchman & Diesler are the architects. This building will adjoin the fifteen-story R. G. Dun Building, for which excavations are now in progress, while the Astor estate will build to the north at the Duane Street corner.

Barney & Chapman, architects, have designed a sixteen-story office building, to be erected at 684 Broadway, for the Rhinelander estate.

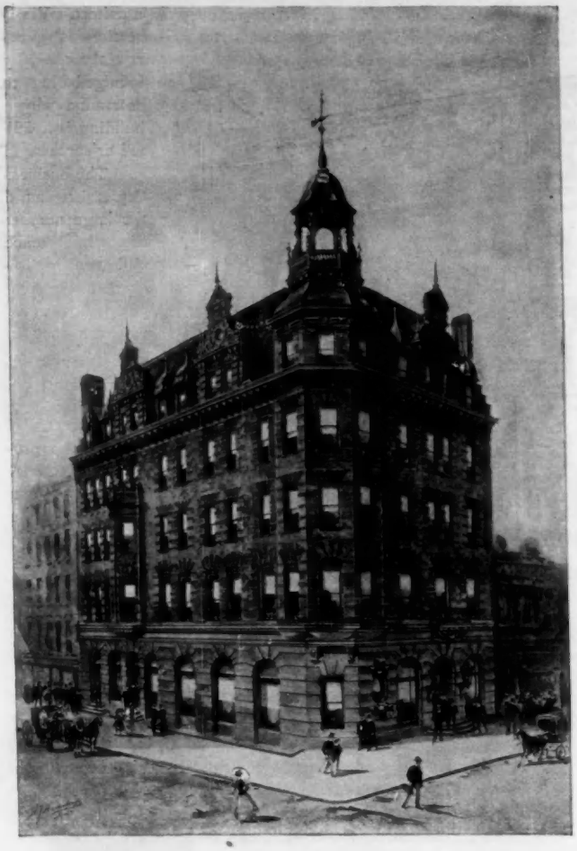
Harding & Gooch have filed plans for an eighteen-story hotel, to be erected on the Paran Stevens property, 44th Street and Fifth Avenue, at a cost of $1,500,000.

Wm. Rankin has filed plans for four five-story brick stores and flats, costing $100,000, to be erected at the southwest corner of Manhattan Avenue and 102d Street.

The city has filed plans for a five-story brick public school building, to be erected on the east side of Avenue A, between 77th and 78th Streets, at a cost of $260,000.

The trustees of the Cathedral of St. John

ST. CHRISTOPHER'S HOSPITAL, FAIRHILL SQUARE, PHILADELPHIA, PA.
Frank Miles Day & Brother, Architects.



OFFICES OF THE NEWARK GAS COMPANY, BROAD ST., NEWARK, N. J.
Henry J. Hardenbergh, Architect.
Front brick furnished by Raritan Hollow & Porous Brick Company.

the Divine ave decided to complete the choir at once; $1,000,000 has been appropriated for this purpose. A bishop's palace is to be commenced as soon as the plans are approved, which will cost $100,000.

KEYS TO FIFTH-STORY APARTMENT HOTEL, 83D STREET AND RIVERSIDE DRIVE, N. Y.
James R. Ware, Architect.
Executed in terra-cotta by the Excelsior Terra-Cotta Company.

CHICAGO.—The exhibition at the Art Institute, under the auspices of the Chicago Architectural Club, which closed April 11, eclipsed all former exhibits. Some eight hundred drawings filled the walls of four galleries. There were very few pen and ink renderings, most of the work being in water color, and many were exceedingly well done. There were no photographs, with perhaps one exception, and no regular working drawings which would show office methods. Very few products of the "allied arts" were admitted, one interesting instance being a bronze door for the new public library.

The Illinois chapter of the American Institute of Architects had offered as a prize to members of the Chicago Architectural Club, who had not been in independent practise more than two years, a gold medal for the best individual exhibit. Instead of the gold

LEHIGH BUILDING, PHILADELPHIA.
Addison Hutton, Architect.
Brown mottled terra-cotta bricks furnished by the Perth Amboy Terra-Cotta Company.

medal, however, three silver medals were awarded, to Messrs. H. M. G. Garden, H. T. Ross, and Victor Traxler.

The Art Institute has provided club rooms for the use of the Chicago Architectural Club in the Institute Building. This step is the first looking toward an affiliation of various kindred organizations at Chicago's art center. New York architects can appreciate the enthusiasm of the Chicago Club over the new departure by imagining the Metropolitan Museum located near their business center, and

offering them not only the use of private club rooms, but access to all the gallery, lecture, and schoolroom privileges.

One more matter in connection with the Art Institute: it will soon have a new auditorium for its lecture courses.

Director French has a plan for distributing the work of the interior decoration which will greatly interest students and graduates. The work will be under one direction, to avoid as far as possible the criticism made even against the decoration of the new Congressional Library—a lack of unity. Mr. Chas. Coolidge is the architect.

The Institute of Architects is making some of their meetings interesting by devoting the greater part of a session to a very frank and free discussion and criticism of the buildings of a particular architect. Vivisection is good-naturedly indulged in to determine why a building is a failure or success.

The business depression and the large number of new office buildings in Chicago have combined to make offices a drug in the market. Good offices can be rented at a very low price.

As to prospective work, R. Bruce Watson has completed the drawings for two pumping stations for the city. The designs, which are very agreeable, are to be executed in brick.

BUSINESS BLOCK, MINNEAPOLIS, MINN.
H. W. Jones, Architect.

Architect S. A. Treat has designed a new lecture hall.

N. S. Patton, architect to the Board of Education, has several new school buildings on hand.

S. S. Beman has made plans for the Studebaker Hotel at South Bend, Indiana, to cost $125,000.

The City Council has been juggling again with the limit of height of buildings. An ordinance was passed reducing it to 90 ft., but it has been raised again to 150 ft.

A matter exciting general interest on the streets, lately, has been the delivery and erection of the colonnade for the new Illinois Trust and Savings Bank. Each shaft is a monolith of Maine granite weighing some twelve or fourteen tons.

GROUP FOR THE BAPTIST PUBLICATION SOCIETY BUILDING, PHILADELPHIA, PA.
Frank Miles Day & Brother, Architects.
Executed in terra-cotta by the Conkling-Armstrong Terra-Cotta Company.

ST. LOUIS.—The unusual activity among builders in the suburbs is regarded as an encouraging sign. There are rumors of numerous large schemes in contemplation, but few are taking definite shape.

The Union Club, which was destroyed by the cyclone, has been rebuilt by architects Grable, Webber & Groves. It is an admirable piece of colonial work in rich red brick with white trimmings. A fine porch with large columns surmounted by a pediment marks the entrance. The building has also been enlarged and arranged for stores on the Jefferson Avenue side.

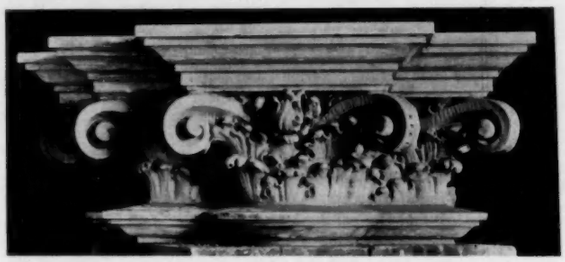
The original building, which was an interesting piece of Romanesque in white stone, was designed by architect T. C. Link, and had only been completed a year or so when it was destroyed.

The new St. Augustine Church on

TERRA-COTTA COLUMN, BUILDING FOR WM. WEIGHTMAN, CHESTNUT STREET, PHILA.
Willis G. Hale, Architect.
Made by Standard Terra-Cotta Company.

Herbert Street is a good example of Gothic architecture. It is built of pink brick with terra-cotta trimmings. The interior is to be finished with groined ceilings which extend to a height not usually seen at the present day. It will cost about $175,000.

The Lionberger Building, a noble example of Richardsonian work, which was destroyed in our million and a quarter dollar fire



TERRA-COTTA CAPITAL, BUILDING FOR WM. WEIGHTMAN, CHESTNUT STREET, PHILADELPHIA.
Willis G. Hale, Architect.
Made by Standard Terra-Cotta Company.

last month, is to be rebuilt by Shepley, Rutan & Coolidge. It is their intention to reproduce the original building as nearly as possible.

PITTSBURG.—Business in the architectural and building lines is brightening, and a considerable amount of work is promised during the coming season.

Architect Wm. Kauffman is the successful competitor in the Greensburg Court House competition; the building is to cost about $400,000.

The Carnegie Steel Company, of this city, has been awarded the contract for the first steel fire-proof building to be erected in the Orient. It is an office and mercantile building to be erected at Tokio, Japan.

Several prominent business men here are interested in the erection of a new family hotel opposite Highland Park. Plans call for a fourteen-story, fire-proof structure, to cost $300,000.

The Exposition Society have planned to expend about $100,000 on improvements to their buildings this year.

The Third Ward Allegheny School Board are contemplating the erection of a brick school building to cost $150,000. It will contain a manual training school and all departments for the education of children in various industrial lines.

Architect Wm. Ross Proctor has completed plans for a new hospital which he will submit to the board of managers of the West Penn Institution. The complete plans call for fourteen buildings.

Architect S. F. Heckert is receiving bids for the erection of the convent building at Millvale, which is to cost $250,000.

The same architect is also preparing plans for a five-story brick Casino for the St. Michael's Roman Catholic congregation on the South Side.

Architect J. L. Beatty was the successful competitor for the

FRIEZE IN MAIN CORNICE, PHILADELPHIA DENTAL COLLEGE, 18TH AND BUTTONWOOD STREETS.
Wilson Brothers & Company, Architects.
Executed in terra-cotta by the Excelsior Terra-Cotta Company.

Woman's U. P. Hospital, which will be erected on Sandusky Street, Allegheny, at a cost of $40,000.

Architect Edward Stotz will prepare plans for the new South Side High School.

Prof. H. L. Braun will build a four-story brick and stone business block, auditorium, and apartment house on S. Highland Avenue, to cost $50,000.

Architect F. C. Sauer has been commissioned to prepare plans for a large brick and stone church and monastery for the Capuchin Fathers, to be erected at Canal Dover, Ohio.

MINNEAPOLIS.—An inquiry among the architects of the Northwest, conducted by the "Improvement Bulletin" of Minneapolis, brings out the fact that few, if any, architects are anticipating any very large undertakings this season.

The architects of Wisconsin have secured the passage of a bill requiring all persons desiring to practise architecture to pay annual fee and be subject to an examination. Illinois architects are also agitating a similar bill. We sincerely hope this will spread until it is requisite in every State.

Our Governor covered himself with glory recently by vetoing a bill framed and engineered through the legislature, changing the site of proposed new hospital for the insane, from Aroka to Hastings. Inasmuch as the State had purchased a site at the former place in good faith, the citizens making a liberal donation to same, the matter was considered by him as closed, and any further agitation as unworthy the dignity and honor of the State. He was upheld by a large majority of the legislature.

Among the larger improvements under way at present may be mentioned: brick residence for Geo. H. Partridge, by Long & Kees, architects, to cost $20,000. Public Library at Rochester, Minn., by C. S. Sedgwick, architect, to cost $18,000, won in competition. School building at Kaukauna, Wis., by Orff & Joralemon, architects, to cost $21,500; and another at Jordan, Minn., same architects, to cost $15,000.

There will evidently be large improvements in the smaller towns, but the cities will do no very great building.

TRADE LITERATURE.

THE recently published catalogue of the Fawcett Ventilated Fire-proof Building Company is before us. The particular system of fire-proof construction which is manufactured and put on the market by this company is in several respects quite different from the ordinary arch block construction. It assumes that fire will readily heat through thin terra-cotta, just as water can be made to boil in an earthen pot, and that if the flange of a beam be once heated sufficiently the beam will expand, deflect, and come down with the floor, causing damage to the building, as well as to the floor itself; and therefore, in order to afford insulation of the lower flange, the Fawcett blocks are so devised as to interpose between the metal and the terra-cotta, a space through which air, when heated, may freely circulate. This is the principle of the Fawcett floor, and it is claimed that though a fire may heat through a plaster ceiling, or may heat the terra-cotta to even a white heat, before it can reach the one vulnerable point, the I beam itself, it must heat through a layer of air which is not confined, and the more intense the heat the more rapid the circulation of the air.

Another claim of the Fawcett construction is that the fire-proofing blocks or sections can be laid without any centering whatever, and will form a ground for a perfectly level and even ceiling. The sections are made in the form of a horseshoe cylinder. These are cut with a bevel at each end of a length so as to just fit between the flanges of two beams, the ends being further rebated so that the lower portion of the terra-cotta section dips below the flange of the beam. As soon as these sections are in place the spaces above are filled in with concrete to receive the finished floor. This construction is doubtless familiar to all our readers, for the Fawcett construction is long past the experimental state, and has been used and

recognized by many leading architects in this country and abroad. It can be adapted to any building or any circumstance, and can be built to carry a superimposed load of anywhere from 50 to 1,500 lbs. per square foot. The catalogue gives a list of the buildings in which this construction has been used, which includes many prominent buildings in our large cities.

NEWS OF THE MONTH.

THE contract for front and inside brick for the Dover Street Bath House has been given to Waldo Brothers.

WALDO BROTHERS have secured the order for front bricks for Paul Revere Schoolhouse, Boston.

THE WHITE BRICK AND TERRA-COTTA COMPANY have removed their New York office from 92 Liberty Street to the Presbyterian Building, 156 Fifth Avenue.

THE FAWCETT VENTILATED FIRE-PROOF CONSTRUCTION COMPANY have contracted for the structural steel work and fire-proofing for the new Probate Court Building, East Cambridge, Mass.

POWHATAN face bricks will be used on alteration of building on Beach Street, Mr. Hennessey, the owner, having placed the order with Waldo Brothers.

THE RALSTON BRICK COMPANY has secured the contract for supplying the brick that will be used in the buildings of the University of the State of New York.

WALDO BROTHERS have sold Alsen Portland and Hoffman Rosendale cements to Richardson & Young for use on section 9, Boston Subway.

HAVING completed the improvement in their plant, which consisted of putting in new machinery, the Ralston Brick Company is running to the limit of their capacity on orders that had accumulated.

C. EVERETT CLARKE & Co., builders of the new building on Congress Street, near Atlantic Avenue, have contracted with Waldo Brothers for Brooks, Shoobridge & Co. Portland and Hoffman Rosendale cements.

THE PITTSBURG TERRA-COTTA LUMBER COMPANY has closed contract for the fire-proofing of the new Baltimore Court House, John Gill & Sons and D. W. Thomas, general contractors. This contract amounted to about $65,000.

THE NELSONVILLE SEWER PIPE COMPANY, of Nelsonville, have purchased an Eagle Re-press from the American Clay-Working Machinery Company. The Nelsonville people report the outlook for business much improved.

WALDO BROTHERS have closed a contract with the city of Newton for the supply of Portland cement for the season of 1897. The city decided to use Brooks, Shoobridge & Co. Anchor brand, although other brands were offered at lower figures.

THE UNION AKRON CEMENT COMPANY, Buffalo, is furnishing their Akron Star Brand Cement on the following work: new building for the Buffalo Street Railway Company; No. 1 School House; also for the fire-proofing in the Lenox Flats, the Otto Building, and the Evans' Building.

CONTRACTS have been recently closed for placing the Bolles Sliding and Revolving Sash in the following buildings: United States Government Hospital, Brooklyn, N. Y.; warehouse, Geo. Blome & Son, Baltimore; Fourth Regiment Armory, Baltimore; large apartment house, Washington, D. C.

THE DES MOINES BRICK MANUFACTURING COMPANY, of Des Moines, Iowa, one of the most progressive firms in the West, are making some extensive improvements and will put in the Eagle Re-presses, and an automatic table of the American Clay-Working Machinery Company's make.

THE STANDARD TERRA-COTTA COMPANY have secured through their New England agents, O. W. Peterson & Co., the contract for the terra-cotta on the Registry of Deeds and Probate Court Buildings, East Cambridge, Mass., O. W. Cutter, architect, Thomas H. Connell, builder.

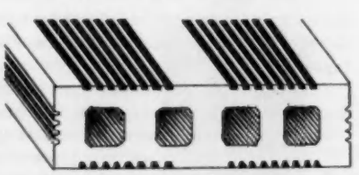
THE new brick plant of W. S. Ravenscroft & Co., at Daguscahonda, Penn., has begun operations, and has already enough orders in hand for gray and buff brick to keep them going on full time for several months. The plant is equipped with Simpson Brick Machines.

THE AMERICAN CLAY-WORKING MACHINERY COMPANY, of Bucyrus, has found it necessary to further increase its force both in the mechanical and clerical departments.

The shops are working full time in every department, some branches putting in extra time in their effort to keep abreast of the orders. More traveling men have been put on the road. There is a general air of old-time business rush with this establishment.

THE PHILADELPHIA AND BOSTON FACE BRICK COMPANY have closed the following contracts: 250,000 plain buff brick, all the molded buff brick, for new passenger station, Boston & Maine Railroad, Manchester, N. H. Red face and molded brick for new high school at Great Barrington, Mass., Henry Vaughan, architect. Molded brick for Norwood Press Company Building, at Norwood, Mass. Molded brick for Phillips Building, at Washington, D. C. Molded brick for Pope Manufacturing Company Building, Washington, D. C. Molded brick for Schiller Turn Verein Building, at Pittsburg, Penn.

THE NEW YORK AND NEW JERSEY FIRE-PROOFING COMPANY has just placed on the market a new style hollow bonding brick, an illustration of which we show herewith. These bricks differ from the regular make of hollow brick in that the holes run crosswise instead of longitudinally. Their size is 8 by 2⅜ by 3½. The idea was suggested by Mr. Snyder, architect of public schools, New York, and they are now specified in the new school buildings.



CHAMBERS BROTHERS COMPANY are about making shipment of some $15,000 worth of brick-making machinery to Nashville, Tenn., to be exhibited at the Tennessee Centennial during the coming summer. They have erected a building especially for their own use, and will have a very interesting exhibit of machinery in practical operation. It is the largest exhibit of the kind that they have ever made, and will embody both end-cut and side-cut auger machines, steam power re-press, disintegrators, dry pans, clay elevators, and dryer equipment, etc.

THE AMERICAN MASON SAFETY TREAD COMPANY, which has nearly completed its work on the Boston Subway, has closed several important contracts lately. It is remodeling the great stairway of Jordan, Marsh & Co., Boston, the iron edge left for the purpose of retaining rubber mats having proved a source of danger. Safety treads are to be placed upon the steps of the Administration Building of the Metropolitan Park Commission, at Revere Beach, Mass., Stickney & Austin, architects; the new Tufts Building, Boston, Rand & Taylor, Kendall & Stevens, architects.

The granite steps of the Lowell Post-office are to be made safe with this material. The company is now putting out a non-slipping, unwearable sidewalk light, to be known as "The Mason Light."

THE EXCELSIOR TERRA-COTTA COMPANY will supply the architectural terra-cotta for the new building for the Catlin estate, Asylum and Main Streets, Hartford, Conn., W. C. Brocklesby, architect; office building for Mr. John Dobson, 9th and Market Streets, Philadelphia, Charles McCaul, architect; the Inter-Ocean Building, Washington, D. C., T. F. Schneider, architect; office building, corner Broadway and Spring Street, Brunner & Tryon, architects; and office building, 598 Broadway, R. Maynicke, architect. All of the above are to be executed in gray terra-cotta.

ANSWERING our request that a list of new contracts made for supplying brick be furnished us for publication, the Columbus Brick and Terra-Cotta Company, Columbus, O., send enough such to fill a column. The following list will indicate the very large field that this company is capable of covering: Dormitory No. 3, Holyoke College, Massachusetts, G. Powell Karr, architect; flats, 134th Street and Seventh Avenue, New York, Geo. F. Pelham, architect; residence, 96th Street, near Central Park, New York, G. A. Shellinger, architect; five flats, 104th Street, New York, G. F. Pelham, architect; five flats, 115th Street, New York, Neville & Bagge, architects; residence, Milwaukee, Wis.; Casper Building, Milwaukee, Wis.; residence, Charleston, W. Va.; Fair Building, Chicago; Townsend Hall, Ohio State University, Columbus, O., Peters, Burns & Pretzinger, architects; Administration Cottage, Boys' Industrial School, Lancaster, O., Yost & Packard, architects.

I. W. PINKHAM COMPANY, Boston, announce their removal from 188 Devonshire Street to more spacious quarters at 206 Devonshire Street, corner of Franklin Street. Although it is but little over a year since the firm moved from their Milk Street office to larger quarters at 188 Devonshire Street, yet the growth of their business has made it necessary to change again to a location that would give them still more room. In their new quarters they have splendid facilities for the display of their samples of fancy front brick and terra-cotta, the arrangement being such that the exhibit has the full benefit of facing the unobstructed light of a south exposure. It is the design of the company to make a large and very complete display of building materials, so that parties seeking information on lines of this nature will be enabled to obtain an accurate idea of their effect when "laid up" in sections.

The firm would be glad to correspond with any clay manufacturers who are not represented in New England, with a view to handling their accounts.

ELK COUNTY, Pennsylvania, has in recent years developed great resources in clay, and it may be of interest to state that every one of the carboniferous clays of the lower cola measures are found at some point in the county. At no point, however, is there such a display of the entire group as is found upon the territory known as the "Ellis lands," lying in the most southern part of the county upon the Pennsylvania & Buffalo, Rochester & Pittsburg, and Erie Railroads.

This tract comprises over 6,000 acres of land, and is of easy access, having also a large area of coal. Natural gas has also been found upon the property.

The clays have been tested by local experts who pronounce it a superior deposit, some seven or eight distinct shades of buff clay being found with colors ranging from cream buff to chocolate.

A vein of the celebrated flint clay has been opened and the highest grade of refractory brick made therefrom.

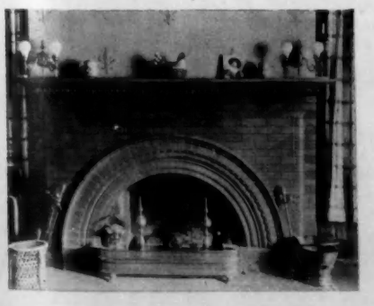
An advertisement in another column offers this very desirable property for sale.

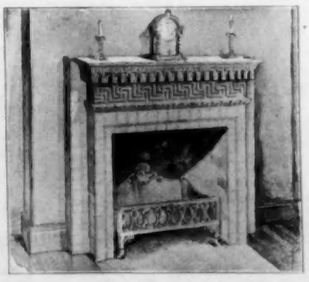
FOR SALE.

TWO COMPLETE OVER-GEARED 8 FT. DRY PANS, WITH 48-IN. PULLEYS, ENTIRELY NEW.

FOR PARTICULARS INQUIRE OF SMITH & CAFFREY, SYRACUSE, N. Y.

The various kinds of Fireplace Mantels in use before we began to make them of Ornamental Brick were good enough as far as they went, but they didn't go far enough. Now ours begin where the others stop. We have cut out the bad, kept the good, and added many better features. Our Brick Mantels were designed with the idea of improving on all other kinds, and they certainly do so. They meet every requirement of artistic interior decoration. The slight variation of shade in the colors of the individual brick serves to break up the monotony, and the effect is soft, warm, and harmonious. Our large variety of designs of molded brick makes it possible to construct a mantel which shall have a bold and striking effect, or a delicate and modest effect, or anything else between the extremes, there being no limit to the happy and pleasing combinations which can be made. The mantels can be set close to the surrounding walls, or can be projected into the room as far as may be desired. They can be made either the main or a secondary feature of the decorative scheme, and in either case they will look better than any other kind — far better. Our customers say so. Our mantels always please at first, and one never tires of them. They always look bright and cheerful and attractive. Furthermore, they don't cost any more than other kinds, and any good brick-mason can set them up from our working plans. Our Sketch Book tells all about 52 designs of various colors costing from $12 upwards. Send for it.





Phila. & Boston Face Brick Co., 15 Liberty Square, Boston, Mass.

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Clearfield Clay Working Co., Clearfield, Pa. xxii
Conkling-Armstrong Terra-Cotta Company, Builders' Exchange, Philadelphia . v
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Philadelphia Office, 24 So. 7th St.
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Ittner, Anthony, Telephone Building, St. Louis, Mo. xx
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Pennsylvania Enameled Brick Company, United Charities Bldg., New York City xvi
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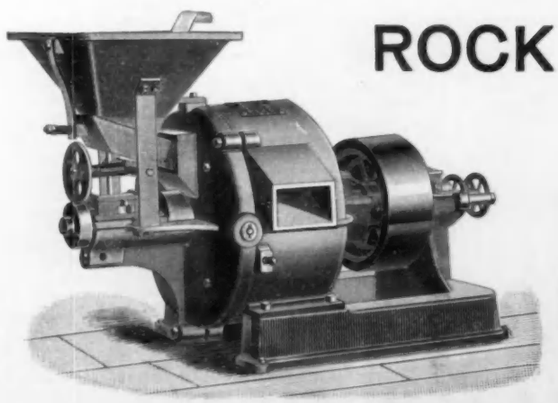

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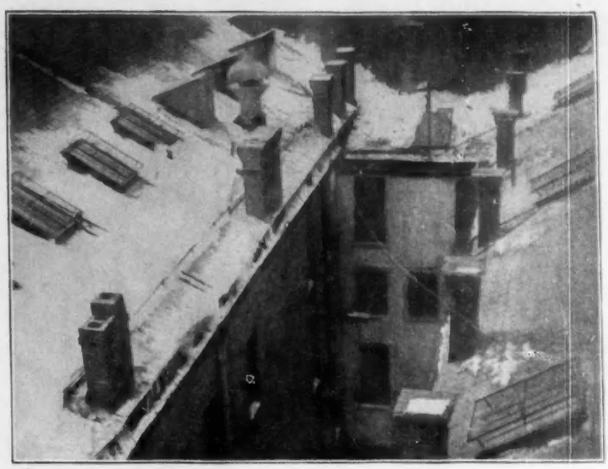

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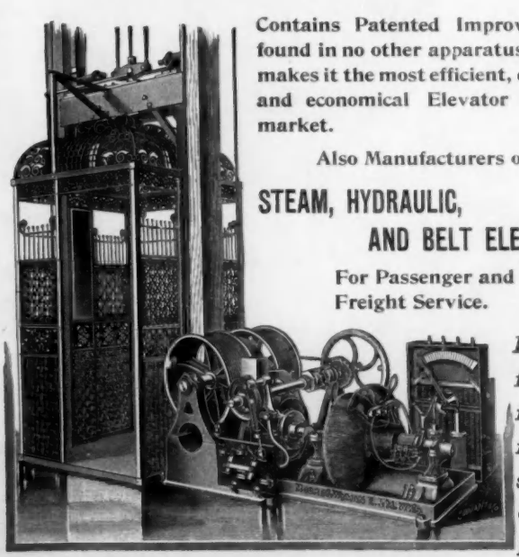

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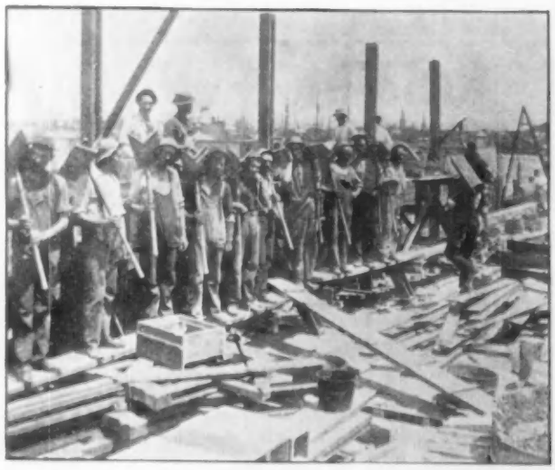

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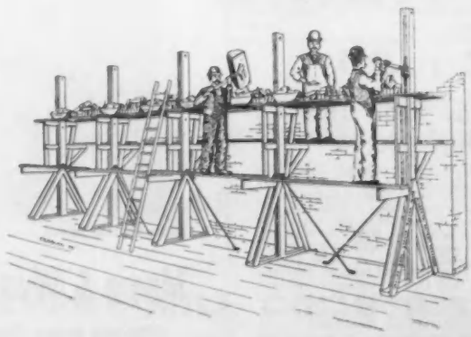

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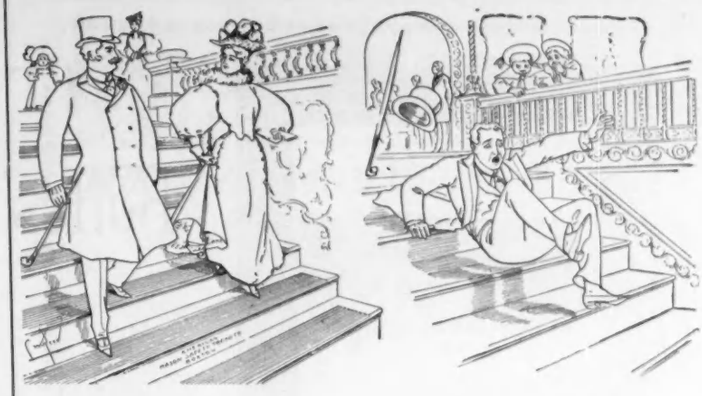

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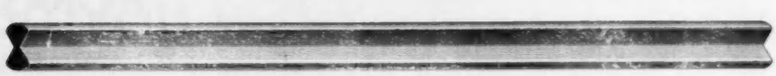

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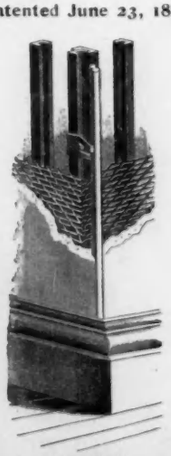

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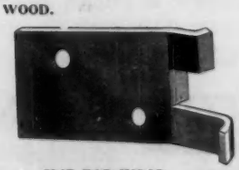

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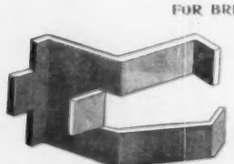
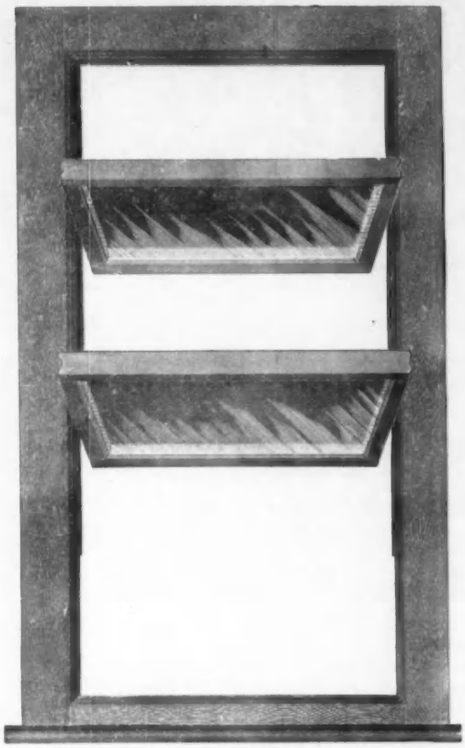
CLIP FOR BRICK.



CLIP FOR STEEL.

AGENTS.

U. G. McQUEEN, 150 Nassau St., NEW YORK, N. Y.
ORGILL BROTHERS & CO., 310 and 312 Front St., MEMPHIS, TENN.
MERRITT & COMPANY, 1026 Ridge Ave., PHILADELPHIA, PENN.
THOMAS JONES, 24 South Main St., ASHEVILLE, N. C.



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PERFECT VENTILATION.

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A COMPLETE SUCCESS!

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G. D. BOGART, PRESIDENT — WM. MALCOLM, SECY AND TREAS.

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This property contains Clays of the most valuable character. Tests show SEVEN SHADES of BUFF CLAY with natural colors ranging from Cream Buff to Chocolate, also PURE WHITE CLAY and GRAY CLAYS, together with veins of the celebrated "FLINT CLAY."

The property contains, also, large areas of COAL DEPOSITS as well as NATURAL GAS, and valuable minerals, and is intersected by two railroads: the Pennsylvania & Buffalo, and the Pittsburgh & Erie Road; thus furnishing the best of shipping facilities.

The property will be sold in lots to suit, at reasonable figures, and is well worth the investigation of any parties seeking a profitable investment. For further information address "ELLMONT," care of The Brickbuilder.

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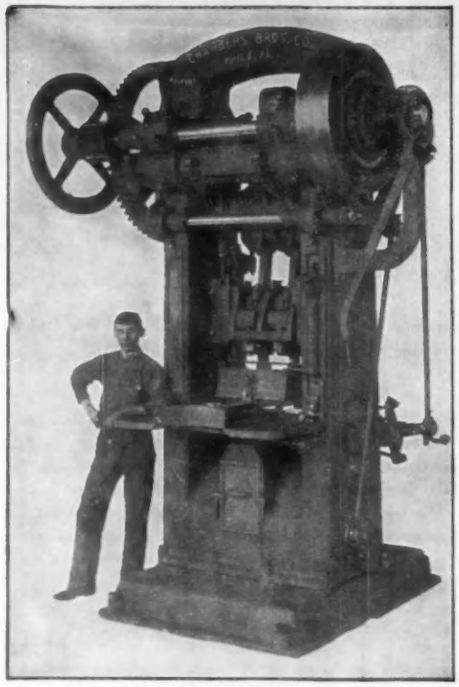

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A strong, stiff machine, with all the pressing machinery above the mold box and away from the dirt. The finished brick is delivered up on a plate, and is never touched by the incoming clot. During the initial pressure any surplus clay in the clot is expelled, and all brick thus gaged to uniform thickness, following which all openings are closed and the finishing pressure applied in a practically tight box. The product is a repressed, tempered clay brick, free from blemish arising from method of delivery, and of practically uniform density and thickness.

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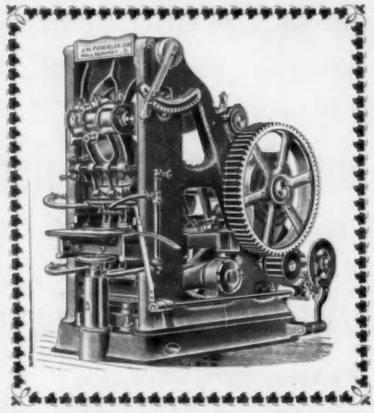
Builders say the brick made on our machinery are better than others; this must be attributed to "the power of the press." If you use our machinery it will help to make your product find favor with the builders.



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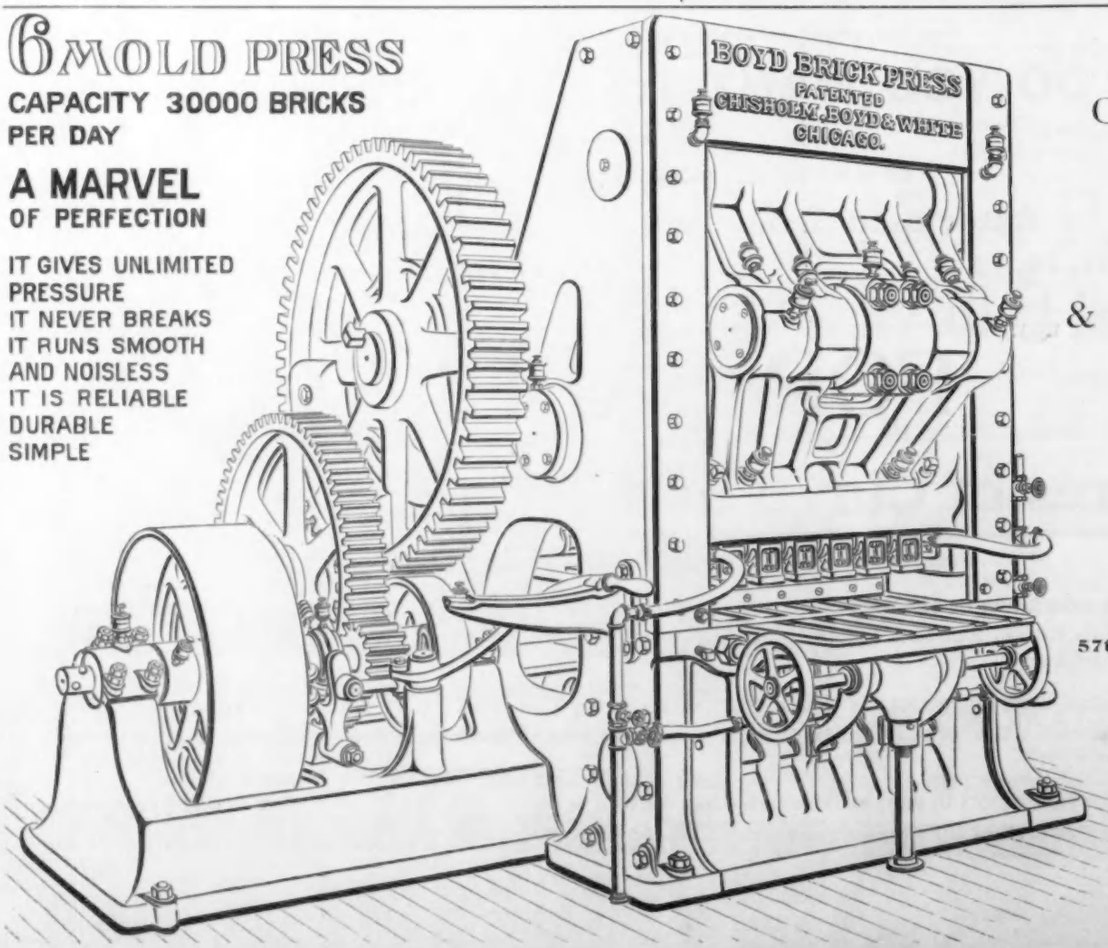

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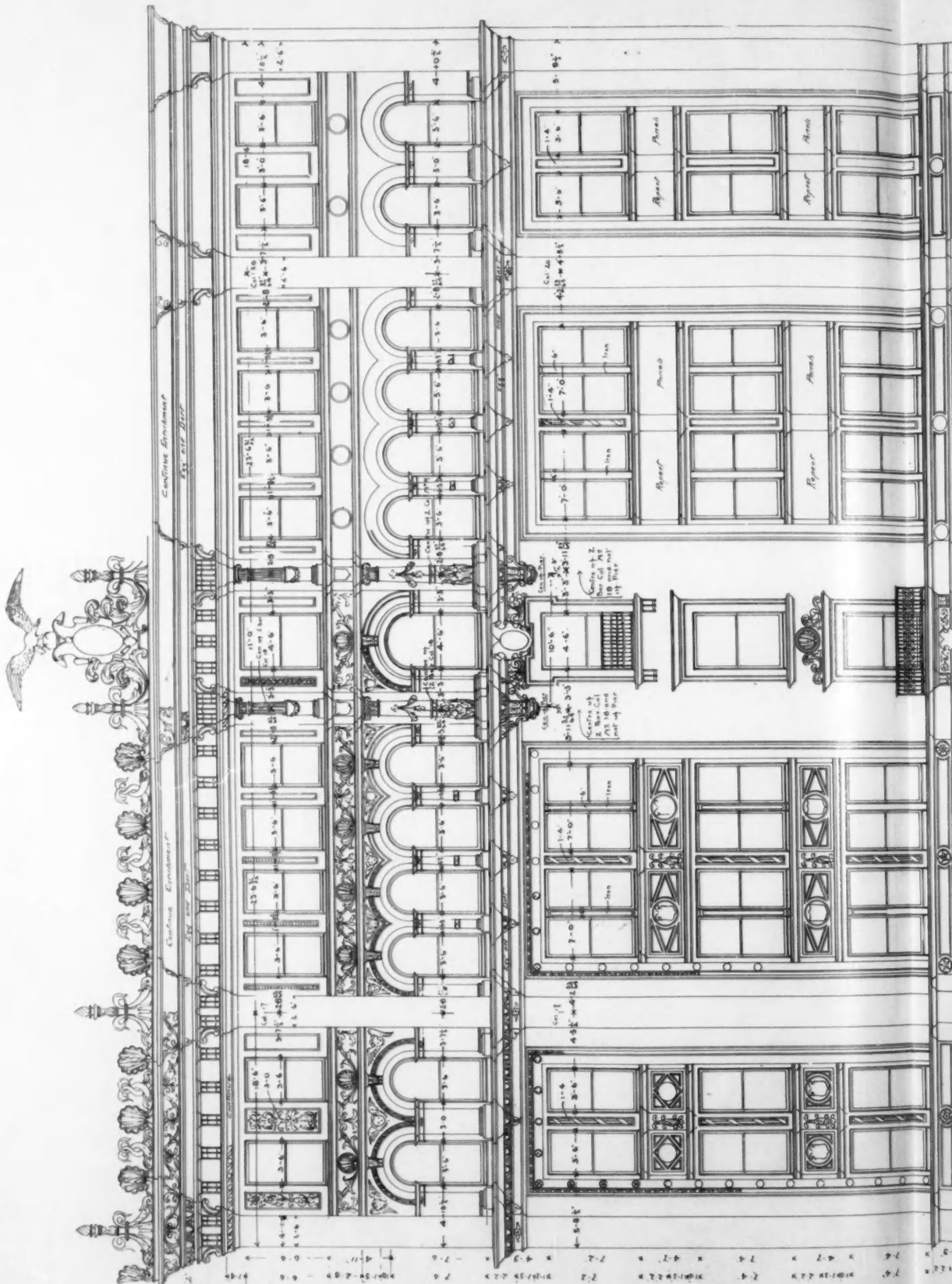

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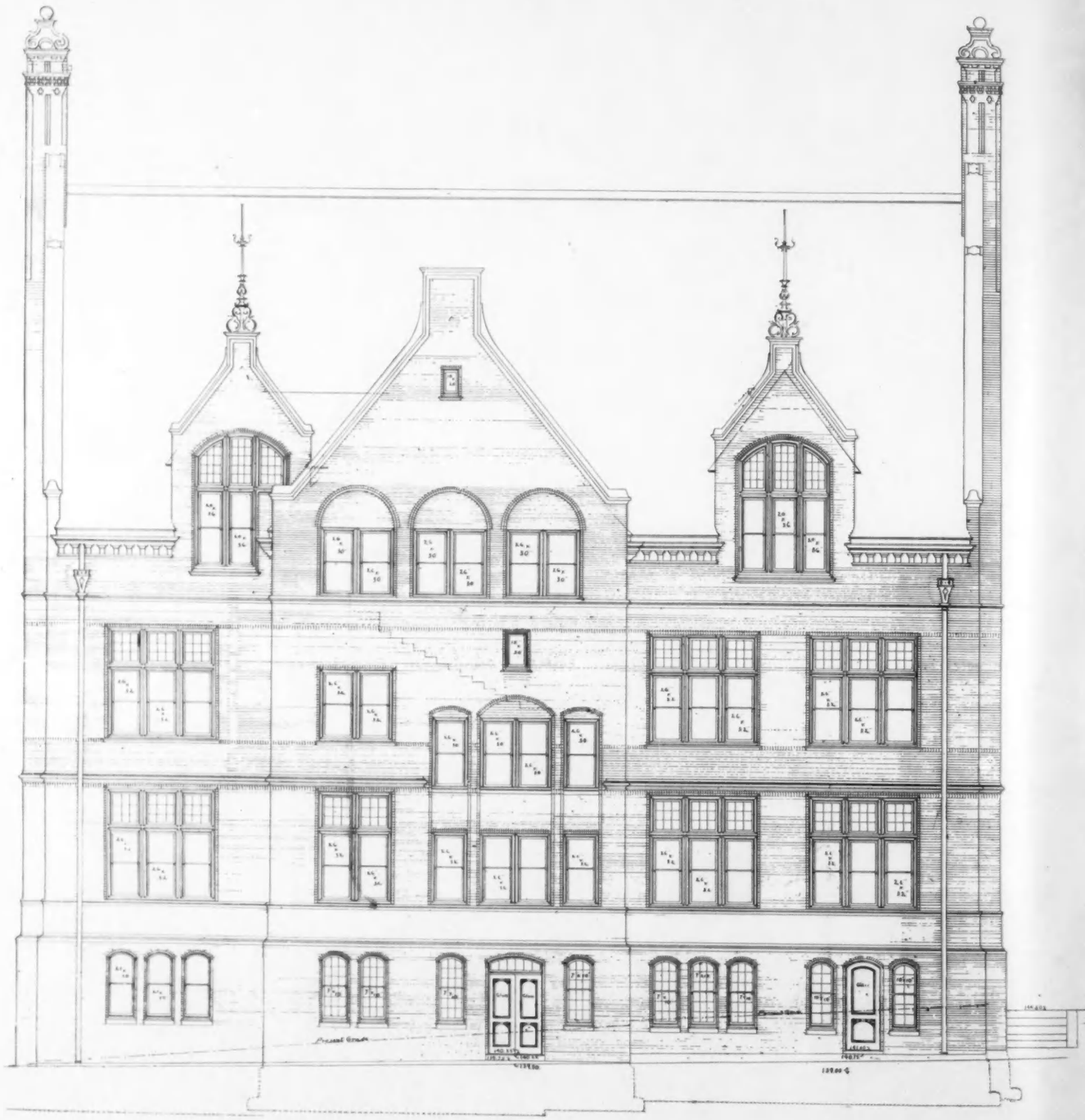
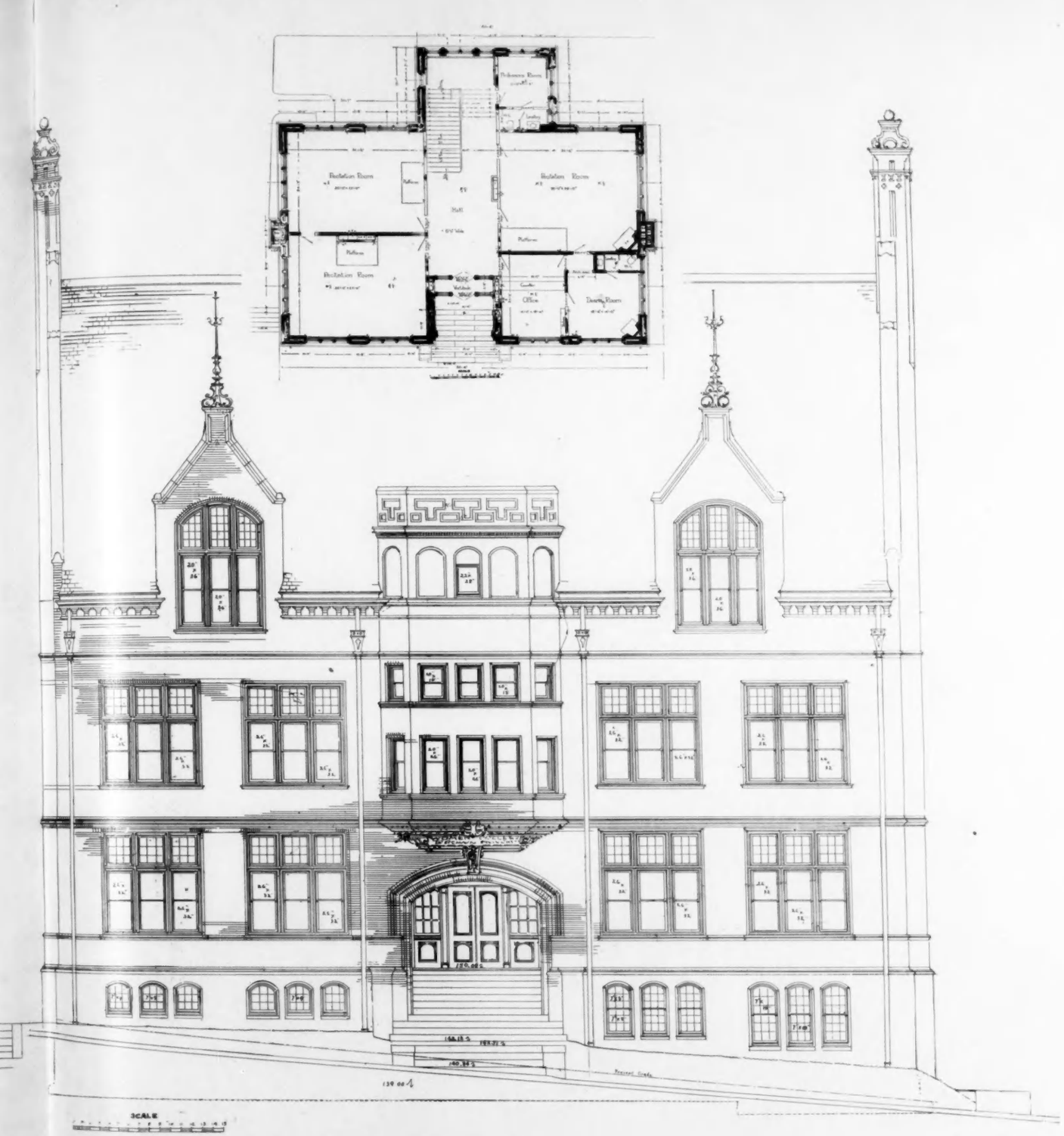
WINSLOW & WETHERELL, ARCHITECTS.



NORTH ELEVATION.

RECITATION HALL, WOMEN'S COLLEGE, BRO
STONE, CARPENTER & WIL



FRONT ELEVATION.

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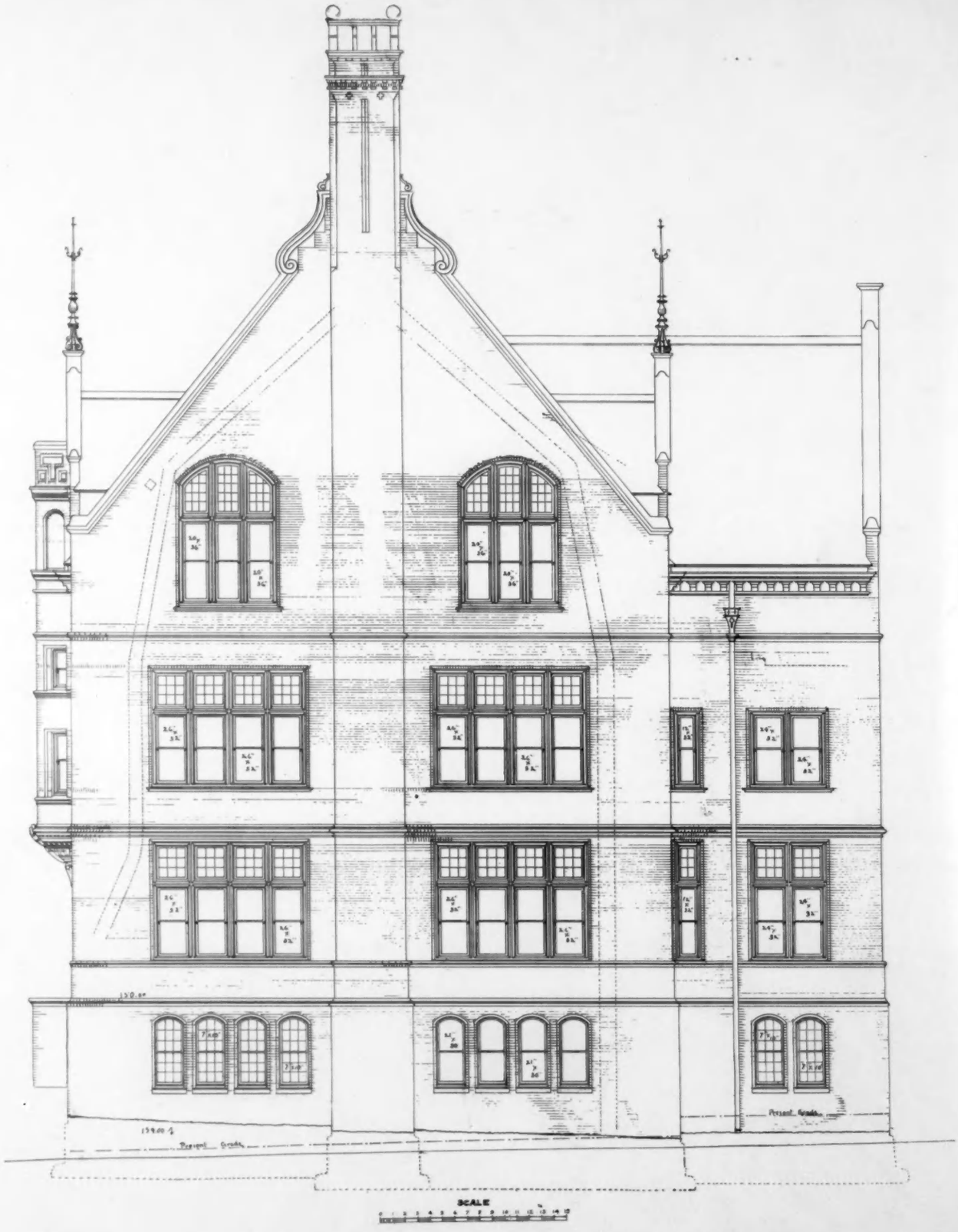

EAST ELEVATION.

RECITATION HALL, WOMEN'S COLLEGE, BROWN UNIVERSITY, PROVIDENCE, R. I.

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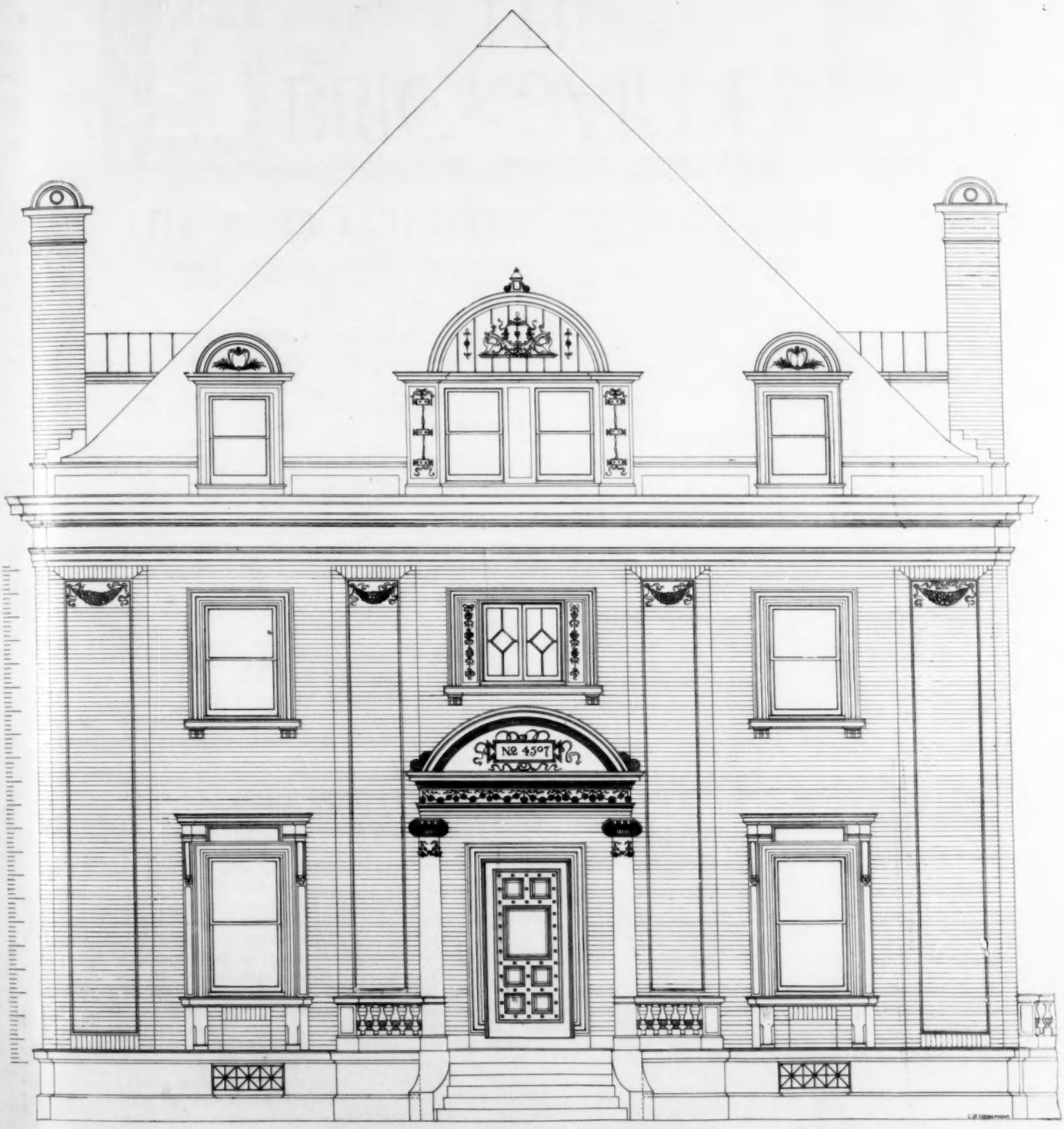

SCALE

RESIDENCE FOR P. A. O'NEIL Esq.

EAMES & YOUNG ARCHITECTS. ST. LOUIS MO.

MATERIALS -
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TRIMMINGS-WHITE TERRA COTTA.
WALLS ——LIGHT GRAY BRICK.
DORMERS-COPPER